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Online at: https://doi.org/10.1088/978-0-7503-1566-1

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ISBN 978-0-7503-1566-1 (ebook)
ISBN 978-0-7503-1564-7 (print)
ISBN 978-0-7503-1565-4 (mobi)

DOI 10.1088/978-0-7503-1566-1

Version: 20171201

IOP Expanding Physics
ISSN 2053-2563 (online)
ISSN 2054-7315 (print)

British Library Cataloguing-in-Publication Data: A catalogue record for this book is available from the British Library.

Published by IOP Publishing, wholly owned by The Institute of Physics, London

IOP Publishing, Temple Circus, Temple Way, Bristol, BS1 6HG, UK

US Office: IOP Publishing, Inc., 190 North Independence Mall West, Suite 601, Philadelphia, PA 19106, USA

Contents

Preface

This book intends to illustrate the development of the generalized tight-binding model in graphene systems. The contents cover the AA, AB, ABC, AAB and sliding configurations and discuss many factors affecting their magneto-electronic properties. The absorption spectra of multilayer graphene systems are investigated in detail under the various stacking configurations, and their competition and cooperation with the applied electric and magnetic field are also studied. The main spectral characteristics focus on the prominent structures, number, intensity and frequency of the absorption peaks. In chapter 2, we introduce the Peierls tight-binding model under electric and magnetic fields. The optical response, which is used to describe the spectral properties, is calculated based on Fermi's golden rule. We start with monolayer graphene in chapter 3, and subsequently discuss AA-stacked trilayer graphene. Symmetry-preserved multi-Dirac-cone structures are responsible for the optical absorption spectra. Intra-Dirac-cone excitations comprise the whole frequency region of the spectra. Chapters 4 and 5 are devoted to AB- and ABC-stacked trilayer graphene. The excitations of massless and massive Dirac quasi-particles dominate the former system, while the vertical transitions between any two inter- or intragroup Landau levels (LLs) are permitted for the latter. In particular, the phenomenon of LL anticrossings in the energy spectrum is discussed and explained using a clear physical picture, especially for the energy width of the sombrero-shaped subbands. This leads to the corresponding non-monotonic dependence of the spectral frequency and intensity on the magnetic field. In chapters 6 and 7, we discuss the optical response under the effects of broken inversion symmetry in AAB-stacked trilayer and sliding bilayer graphene. The low-symmetry stacking configurations trigger more significant LL anticrossings and cause distinct features for the K- and K′-splitting LLs.

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Chapter 1

Introduction

Graphene is a 2D material made up of hexagonal carbon lattices [1, 2]. Since mono- and few-layer graphene sheets were first fabricated in 2004 [1, 2], low-dimensional graphene-related systems have been of great interest in experimental and theoretical studies. The stacking order of graphene sheets includes the essential sequences of AA [3, 4], AB [5–9], ABC [5, 8–11] stacking. While the AA stacking configuration has only been made artificially from intercalated graphite compounds, the AB and ABC configurations are common orders in natural graphite, with their respective estimated volume fractions of 80% and 14% [15, 16]. The remaining ~6% consists of haphazardly stacked graphene sheets in a turbostratic configuration [17–19]. Few-layer graphene with the desired specific stacking configuration can be exfoliated from highly orientated pyrolytic graphite [1, 2] as well as chemically and electrochemically reduced from graphene oxide [20–27]. Nevertheless, the chemical vapor deposition method has the advantage of producing large-scale, high-quality graphene sheets. Recently, a large area of graphene with high mobility and highly symmetric configurations, e.g. AA, AB and ABC, was found in chemical vapour deposition (CVD)-grown samples [28–40]. The improved quality is adequate for research experiments and industrial applications [41–49]. In addition, AAB stacking and intermediate bilayer configurations, with relative layer-layer shifts or twists, have also been found and are becoming interesting subjects [59–67]. Synthesized graphene is generally comprised of different kinds of domain due to the tiny difference between the total energies of the different configurations. Infrared spectroscopy, transmission electron microscopy (TEM) [3–5, 34], scanning tunneling microscopy (STM) and spectroscopy (STS) [6–9, 11, 35–37], angle-resolved photoemission spectroscopy (ARPES) [68–74], and Raman spectroscopy [10, 75, 76], can be used to visualize the stacking domains with nanometric resolution for cases of tri-, tetra- and pentalayer graphene with typical or intermediate configurations.

Monolayer graphene belongs to a gapless system which possesses extremely high carrier mobility of up to 15 000 $cm^2\ V^{-1}\ s^{-1}$ [1]. P R Wallace discovered that the low-energy spectrum around the corners K and K′ in the Brillouin zone is described

doi:10.1088/978-0-7503-1566-1ch1

by isotropically conical dispersions in the framework of the nearest-neighbor tight-binding model [77]. The conical band structure and the vertex points at K and K′ are known as the Dirac cone and Dirac points, respectively. The linearly dispersed quasi-particles in graphene behave as relativistic Dirac fermions with an effective speed of light $\simeq c/300$ (c is the speed of light). Few-layer graphene with specific stacking configurations, e.g. AA [78–80], AB [81–93], ABC [93–99] and AAB [64], are predicted to display unique electronic energy dispersions. This new material holds great promise for the development of next-generation electronic and optoelectronic nanodevices [41–47, 50–56] because the electronic and optical properties can be flexibly tuned by the application of external fields [64–74] as well as changes to the geometric structures [75–114] and dopants [115–122]. The stacking configurations have been experimentally and theoretically verified to have great significance for the magneto-electronic and optical properties [64–67, 108, 124–189], shedding some light on other intriguing structure-specific physical properties, e.g. the Coulomb excitations and the quantum Hall transport properties [190–221]. The essential properties under previous investigations are rather different from those in other layered materials, conventional metals, semiconductors and topological insulators [222–235]; they are dominated by the interplay between the external fields and the specific geometric symmetries. In this paper, we thoroughly review the electronic and optical properties of multilayer graphene to explore its response under external fields with respect to the specific AA, AB, ABC, AAB and sliding configurations.

In AA-stacked graphene, all the graphene sheets are identically stacked along the $\hat{z}$ direction [126, 153]. The low-energy band structure consists of several monolayer-like massless Dirac cones [78–80, 153], which are exactly located at the two valleys K and K′, while the energies of the Dirac points shift away from the Fermi energy due to the vertically projected geometry. The absorption spectrum is, in general, a superposition of monolayer-like spectra, because only the vertical excitations of intra-Dirac-cones are permitted, regardless of the external electric and magnetic fields [153, 183]. However, the stacking effect gives rise to an optical gap for the even-layer configurations, which is a forbidden optical transition zone resulting from free carriers in the Dirac cones. The middle-frequency spectrum shows symmetric peaks as a result of the saddle-point excitation channels around the M point. Such peaks are also observed for other stacked graphene, as well as being a critical characteristic of sp^2-bonding carbon systems. In a uniform perpendicular magnetic field $B = B_0\hat{z}$, the Landau level (LL) spectrum behaves in the same way as several groups of monolayer-like spectra [126, 153, 183]. Responsible for each Dirac cone, the quantized LLs of each group are characterized by a set of single quantum modes, and their energies can be described by a square root dependence on B_0. Therefore, the magneto-absorption spectrum consists of several monolayer-like spectra with delta-function-like absorption peaks following the optical selection rule of $\Delta n = \pm 1$ [153, 183]. A forbidden transition region and a discontinuous threshold frequency would be revealed for all the bilayer-like intragroup LL transitions, as the Fermi level ($E_F = 0$) deviates from the Dirac point. Moreover, the preservation of the optical and electronic properties of the massless Dirac fermions indicate the unchanged spatial symmetry of the chemical environment under the external fields.

AB-stacked graphene is a fascinating material which has attracted intense attention due to the nature of its massless and/or massive Dirac fermions, depending on whether the numbers of their stacking layers are even or odd [82–93]. Of special interest is the electronic structure, which can be essentially characterized by the superposition of monolayer-like and bilayer-like structures. Optical excitation channels accessible to the monolayer-like and bilayer-like subbands construct the optical spectrum [81, 100, 154–157]. Under an electric field, bilayer graphene shows a sharp peak due to new transition channels within the energy gap (up to 100 meV) [102, 103, 107, 109], and for cases in which there are more than three layers, displays enhanced semimetal characteristics attributed to the significant overlap of the low-energy subbands [101, 109, 110, 114]. In particular, as a result of the nearly isotropic energy dispersions around the K point, quasi-1D asymmetric peaks are revealed for the vertical excitations between two constant energy loops. Electric-field-induced characteristic peaks are also observed in other stacking systems. On the other hand, a magnetic field gives rise to interesting Landau quantization phenomena in the electronic and optical properties of odd-layer symmetry-broken graphene and even-layer inversion-symmetry graphene [126, 128–131, 141, 142]. Massless and massive Dirac quasi-particles reveal single- and twin-peak structures, respectively, in the monolayer-like and bilayer-like spectra [65, 158]. The corresponding ratio of the peak intensities is estimated to be about 2:1. In the presence of an electric field, the magneto-excitation channels around K and K′ are separated from each other due to LL splitting, so that the channel numbers become double those under zero electric field [126]. In addition, very few LLs with a special quantum mode relationship avoid crossing each other during the variation of the magnetic or electric field; these are characterized by the main quantum mode and the side modes under the hybridization of the LLs [126, 131, 149]. Extra optical selection rules are induced for such LLs with multi-quantum-modes in addition to the ordinary $\Delta n = \pm 1$. In certain regions of the absorption spectra, the effects of geometry breaking and the anticrossings of intergroup LLs would trigger some special peaks without the simple relationships between the intensity, frequency and field strength.

Few-layer ABC-stacked graphene is a semimetal [93–99]. The electronic structure is characterized by one pair of partially flat subbands near $E_F = 0$, and pairs of sombrero-shaped subbands near the energy of the vertical atomic interactions between the nearest-neighboring layers [93–99]. Contributed by the surface-localized states [97–99], the partially flat subbands give rise to a prominent peak in the density of states (DOS) and play an important role in the low-frequency optical spectrum [110, 112]. An electric field can separate the two partially flat bands and trigger a new kind of optical channel responsible for a gap transition [110, 112]. Under a magnetic field, the intergroup and intragroup excitation channels among well-behaved LLs comprise the main part of the absorption spectrum [146, 174–176], in which the absorption peaks show a twin-peak structure because the LL energy spectrum is asymmetric about $E_F = 0$ [175, 176]. Moreover, it is interesting to study the quantization effects of any two constant energy loops in the sombrero-shaped structure, where the quantized energies of the LLs are proportional or inversely proportional to the magnetic field strength [126, 146, 147]. This leads to many

anticrossings of intragroup LLs in the ABC stacking configuration. By varying the electric field strength, one can suppress or enhance the degree of LL anticrossings and change the components of the main mode and side modes, that is, one can induce and modulate optical channels for progressive LLs during the variation of the field strength. Furthermore, the absorption spectrum is no longer dominated by a twin-peak structure but rather by a double-peak structure under a sufficiently large electric field—a transition which is attributed to the spatial symmetry breaking of the LL subenvelope functions.

AAB-stacked graphene exhibits an extraordinary band structure compared to the AA, AB and ABC systems, mainly due to the low symmetry of its stacking geometry [64]. In the case of the trilayer system, AAB-stacked graphene is a narrow-gap semiconductor which presents a pair of subbands with strong oscillatory energy dispersions near $E_F = 0$. With increasing energy, pairs of sombrero-shaped and parabolic bands appear in substantial amounts. In the low-frequency region, rich optical excitation channels cause many absorption peaks, some of which show quasi-1D asymmetric divergence due to the vertical excitations between two constant energy loops. The LLs coming from the two valleys K and K′ are obviously separate in the mirror symmetry broken system [64]. The results present certain important differences for the state degeneracy, spacing, quantum number and spatial distribution of the wavefunctions, as compared with the highly symmetric configurations. Furthermore, the low-symmetry geometry of the AAB configuration implies the ease of triggering complex patterns of LL anticrossings and the richness of the magneto-absorption spectra. At low energies, the oscillatory subbands can induce triple-degenerate Landau states under the condition of three constant energy contours. In the B_0-dependent LL spectrum, there are many prominent multicrossings and anticrossings, i.e. the existence of both well-behaved and perturbed subenvelope functions, and sometimes abnormal ones resulting from severe LL hybridizations. Accordingly, intergroup and intragroup LL anticrossings are both shown for various regions, and they even coexist in a narrow region. The optical characteristics resulting from either the intragroup or intergroup inter-LL excitations are remarkably different for the K- and K′-valley splitting states. The main reason for this is the phase and amplitude of the LL wavefunctions.

An intermediate bilayer configuration is formed from AA to AB, and then to AA′, as the two graphene sheets shift relative to each other in the armchair direction [66, 148]. The two Dirac cones transform into parabolic bands from AA to AB configurations, and for a further layer-layer shift, they tilt towards each other at a small angle, restoring the AA′ configuration. It should be noted that the two Dirac points are located at different wave vectors and energies once the stacking configuration deviates from the AA configuration. Furthermore, an eye-shaped stateless region is formed near $E_F = 0$ as a result of the strong hybridization of Dirac cones. The dramatic transformation between the Dirac cone structure and the parabolic band structure leads to drastic changes to the optical response under external electric and magnetic fields. The layer-layer shift has a significant impact on the LLs in sliding bilayer systems. In addition to the well-behaved and perturbed LLs stemming from the massless and massive Dirac fermions in the highly symmetric AA and AB

configurations, some undefined LLs appear to be promising in the case of a significant mixture of LLs, as the geometry deviates from the typical configurations. However, there is an absence of any regular optical selection rule for such undefined LLs, because their wavefunctions display extremely irregular oscillations without a dominating quantum mode. On the other hand, when the AA′ configuration is built, the LLs become well-behaved again, while additional optical channels and selection rules are accessible for intragroup LL excitations within the tilted Dirac cones. In the case of different bilayer configurations, it would be worthwhile to investigate the considerate shift-induced absorption peaks, which appear in a wide range of anticrossing patterns in the field-dependent energy spectrum.

The electronic properties are studied by use of STM, STS [6–9, 11] and ARPES [10, 68–76]. The band structures based on the tight-binding model agree with the first principles calculations [64, 66, 77, 78, 80–84, 89, 90, 93, 94, 96, 148]. The isolated Dirac cones are clearly seen in the monolayer graphene [69, 71, 73, 74], and the stacking effects for the typical configurations, AA, AB and ABC, are also identified by the main characteristics of the band structures [78, 80, 82, 126]. The former two show multiple Dirac cone dispersions and the superposition of monolayer-like and bilayer-like dispersions respectively [8], while the latter is not analogous to the AA and AB configurations [68, 70]. On the other hand, the deformation of Dirac cones for the AAB- and sliding bilayer configurations [64, 66, 148] can be verified by using ARPES. The aforementioned electronic characteristics have also been confirmed in absorption [164, 166–168, 173, 174, 177], transmission [180, 181], refection [136], Raman scattering and Rayleigh scattering spectroscopy [75, 76, 138, 139, 171, 172, 236–243]. The evidence of Dirac cones has been observed for monolayer graphene in terms of the zero threshold frequency and the linear dependence of the intensity on the frequency. The low-frequency spectral features have also been verified for the AB- and ABC-stacked samples on SiO_2/Si substrates. Furthermore, the results provide spectroscopic evidence of a tunable gap in biased AB-stacked bilayer and ABC-stacked trilayer graphene through the observation of new gap-induced absorption peaks, with a blue or red shift at different gate voltages [109, 110]. The gap size is compatible with the theoretical calculations based on the tight-binding model and *ab initio* theory [100–106]. Transport and STS measurements also give the modified electronic properties under the electric field, including the enhanced semimetal properties of AB-stacked trilayer graphene [108, 112–114]. The electric-field-induced excitations rely on the geometric structure; that is to say, verifications of the spectral structure would be worthwhile in further research to identify the interlayer atomic interactions and geometric structures.

The quantized LL energies directly correspond to the prominent DOS peaks measured in STS, where the LLs near $E_F = 0$ have been identified for monolayer, AB-stacked bilayer and trilayer as well as ABC-stacked trilayer graphene [244–254]. Quantum Hall transport measurements also observe the sequence of the LLs [203–220]. Furthermore, low-energy optical transitions with specified selection rules are verified for the intergroup LLs near $E_F = 0$ in the infrared transmission, absorption and magneto-Raman spectra [75, 76, 136, 138, 139, 164, 166–168, 171–174,

177, 180, 181, 236–243]. The spectral features of the equivalent monolayer-like and bilayer-like Landau quantization are, respectively, identified by the square root and linear dependence of the energies on the magnetic field strength in the infrared transmission of AB-stacked trilayer graphene and in the magneto-Raman spectroscopy of AB-stacked graphene up to five layers [171]. For ABC-stacked trilayer graphene, while quantum Hall effect (QHE) transport measurements show the low-lying LLs [217–219], experimental evidence on the inter-LL excitations—distinct from the massless and massive Dirac fermion excitations—is needed for further verification. The crossings and anticrossings of LLs enrich the essential magneto-electronic and optical properties [64–66, 126, 131, 135, 146, 147, 175]. The former has been confirmed by the shift of plateaus in QHE measurements due to the increase in the LL degeneracy [214–220]. Regarding the latter, one can use optical spectroscopy to identify the non-monotonic changes in the structures, frequencies, intensities and numbers of the absorption peaks [175]. This phenomenon is expected to be more significant in low-symmetry AAB-stacked and sliding bilayer graphene [65, 66]. In sufficiently low magnetic fields, the spectral features reflect the band structures, such as the symmetry, energy dispersions and atomic interactions, as well as the broken mirror symmetry under the electric field. These experimental results can be used to identify the stacking configurations and the tight-binding parameters.

In this work, the generalized tight-binding model is developed to investigate optical properties of graphene in magnetic and electric fields. The $2p_z$-dominated Hamiltonian is built from the subspace spanned by a lot of tight-binding functions in an enlarged unit cell. Its dimension is determined by the commensurate period of the geometric structure and external field. This model can be utilized in cases where many kinds of external fields are applied, e.g. uniform/modulated magnetic fields [124, 125, 150], modulated electric fields and composite fields [151]. This is suitable for multi-layer graphene [126, 128, 143, 144] and bulk graphite [255, 256] with arbitrary stacking configurations. The most important interlayer atomic interactions and external fields are simultaneously taken into account without the need to treat either of them as a perturbation term. The Hamiltonian matrix for determining the magneto-electric properties becomes too large for the experimental field strengths. By using an exact diagonalization method, the eigenvalues and eigenfunctions of the Hamiltonian matrix are efficiently solved. The developed model can be further used to understand other essential material properties by combining the single- and many-particle theories, such as optical spectra and electronic excitations [158, 159, 162, 175, 176, 190–196]. On the other hand, the effective mass approximation is frequently adopted to comprehend the electronic and optical properties. The low-lying energy bands are expanded about the high-symmetry point, and then magnetic quantization is done for the approximate properties. The magneto-optical absorption spectra are calculated for the AA- [127] and AB-stacked graphene [165]. Detailed comparisons of these two methods will be made in later discussions.

This book broadly covers the fields related to multilayer graphene systems in the forms of AA, AB, ABC, AAB and sliding configurations, and discusses many of the factors which affect their magneto-electronic properties. The absorption spectra of multilayer graphene systems are discussed in detail under various stacking

configurations, and their competition and cooperation with the applied electric field and magnetic field are also discussed. The main spectral characteristics focus on the prominent structures, number, intensity and frequency of absorption peaks. In chapter 2, we introduce the Peierls tight-binding model under electric and magnetic fields. The optical response, used to describe the spectral properties, is calculated based on Fermi's golden rule. We start with monolayer graphene in chapter 3, and subsequently discuss AA-stacked trilayer graphene. Symmetry-preserved multi-Dirac-cone structures are responsible for the optical absorption spectra. Intra-Dirac-cone excitations comprise the whole frequency region of the spectra. Chapters 4 and 5 are devoted to AB- and ABC-stacked trilayer graphene. The excitations of the massless and massive Dirac quasi-particles dominate the former system, while the vertical transitions between any two inter- or intragroup LLs are permitted for the latter. In particular, the phenomenon of LL anticrossings in the energy spectrum is discussed and explained using a clear physical picture, especially for the energy width of the sombrero-shaped subbands. This leads to the corresponding non-monotonic dependence of the spectral frequency and intensity on the magnetic field. In chapters 6 and 7, we discuss the optical response under the effects of broken inversion symmetry in AAB-stacked trilayer and sliding bilayer graphene. The low-symmetry stacking configurations trigger more significant LL anticrossings and cause distinct features for the K- and K′-splitting LLs.

At the beginning of each chapter, we present the Peierls Hamiltonian and the spectral function with respect to each system. We focus on the mechanism of the optical excitations responsible for the spectral characteristics based on the LL spectra and wavefunctions. The electric-field-enriched optical properties are also discussed. Optical absorption experiments are available for the investigation of the layer and stacking dependence of the magneto-electronic properties. Meanwhile, a detailed comparison of these systems is also presented in chapter 7. Finally, chapter 8 contains the concluding remarks.

References

[1] Novoselov K S, Geim A K, Morozov S V, Jiang D, Zhang Y and Dubonos S V *et al* 2004 Electric field effect in atomically thin carbon films *Science* **306** 666–9

[2] Novoselov K S, Jiang D, Schedin F, Booth T J, Khotkevich V V and Morozov S V *et al* 2005 Two-dimensional atomic crystals *Proc. Natl Acad. Sci. USA.* **102** 10451–3

[3] Lee J K, Lee S C, Ahn J P, Kim S C, Wilson J I B and John P 2008 The growth of AA graphite on (1 1 1) diamond *J. Chem. Phys.* **129** 234709

[4] Liu Z, Suenaga K, Harris P J F and Iijima S 2009 Open and closed edges of graphene layers *Phys. Rev. Lett.* **102** 015501

[5] Borysiuk J, Soltys J and Piechota J 2011 Stacking sequence dependence of graphene layers on SiC (000-1)—experimental and theoretical investigation *J. Appl. Phys.* **109** 093523

[6] Cherkez V, Trambly de Laissardiere G, Mallet P and Veuillen J Y 2015 Van Hove singularities in doped twisted graphene bilayers studied by scanning tunneling spectroscopy *Phys. Rev.* B **91** 155428

[7] Yan W, Liu M, Dou R F, Meng L, Feng L and Chu Z D *et al* 2012 Angle-dependent van Hove singularities in a slightly twisted graphene bilayer *Phys. Rev. Lett.* **109** 126801

[8] Lauffer P, Emtsev K V, Graupner R, Seyller Th, Ley L and Reshanov S A *et al* 2008 Atomic and electronic structure of few-layer graphene on SiC(0001) studied with scanning tunneling microscopy and spectroscopy *Phys. Rev.* B **77** 155426
[9] Hattendorf S, Georgi A, Liebmann M and Morgenstern M 2013 Networks of ABA and ABC stacked graphene on mica observed by scanning tunneling microscopy *Surf. Sci.* **610** 53–8
[10] Norimatsu W and Kusunoki M 2010 Selective formation of ABC-stacked graphene layers on SiC(0001) *Phys. Rev.* B **81** 161410
[11] Warner J H, Mukai M and KirklandA I 2012 Atomic structure of ABC rhombohedral stacked trilayer graphene *ACS Nano.* **6** 5680–6
[12] Rong Z Y and Kuiper P 1993 Electronic effects in scanning tunneling microscopy: moiré pattern on a graphite surface *Phys. Rev.* B **48** 17427
[13] Campanera J M, Savini G, Suarez-Martinez I and Heggie M I 2007 Density functional calculations on the intricacies of moiré patterns on graphite *Phys. Rev.* B **75** 235449
[14] Biedermann L B, Bolen M L, Capano M A, Zemlyanov D and Reifenberger R G 2009 Insights into few-layer epitaxial graphene growth on 4H-SiC$(000\bar{1})$ substrates from STM studies *Phys. Rev.* B **79** 125411
[15] Bernal J D 1924 The structure of graphite *Proc. R. Soc. London, Ser.* A **106** 749
[16] Lipson H and Stokes A R 1942 The structure of graphite *Proc. R. Sot. London, Ser.* A **181** 101
[17] Charlier J C, Gonze X and Michenaud J P 1994 First-principles study of the stacking effect on the electronic properties of graphite(s) *Carbon* **32** 289–99
[18] Charlier J C, Michenaud J P and Ph Lambin 1992 Tight-binding density of electronic states of pregraphitic carbon *Phys. Rev.* B **46** 4540–3
[19] Shallcross S, Sharma S, Kandelaki E and Pankratov O A 2010 Electronic structure of turbostratic graphene *Phys. Rev.* B **81** 165105
[20] Bracamonte M V, Lacconi G I, Urreta S E and Foa Torres L E F 2014 On the nature of defects in liquid-phase exfoliated graphene *J. Phys. Chem.* C **118** 15455–9
[21] Stankovich S, Dikin D A, Piner R D, KohlhaasK A, Kleinhammes A and Jia Y *et al* 2007 Synthesis of graphene-based nanosheets via chemical reduction of exfoliated graphite oxide *Carbon* **45** 1558–65
[22] Song P, Zhang X, Sun M, Cui X and Lin Y 2012 Synthesis of graphene nanosheets via oxalic acid-induced chemical reduction of exfoliated graphite oxide *RSC Adv.* **2** 1168–73
[23] Guo H L, Wang X F, Qian Q Y, Wang F B and Xia X H 2009 A green approach to the synthesis of graphene nanosheets *ACS Nano.* **3** 2653–9
[24] Dou L T, Cui F, Yu Y, Khanarian G, Eaton S W and Yang Q *et al* 2016 Solution-processed copper/reduced-graphene-oxide core/shell nanowire transparent conductors *ACS Nano.* **10** 2600–6
[25] Tang L, Wang Y, Li Y, Feng H, Lu J and Li J 2009 Preparation, structure, and electrochemical properties of reduced graphene sheet films *Adv. Funct. Mater.* **19** 2782–59
[26] Anis A, Mohammad A A, Hussain A and Ahmed S E 2016 Reduced graphene oxide thin film on conductive substrates by bipolar electrochemistry *Sci. Rep.* **6** 21282
[27] Sundaram R S, Gomez-Navarro C, Balasubramanian K, Burghard M, Marko K K and Klaus K 2008 Electrochemical modification of graphene *Adv. Mater.* **20** 3050–3
[28] Reina A, Jia X, Ho J, Nezich D, Son H and Bulovic V *et al* 2009 Large area, few-layer graphene films on arbitrary substrates by chemical vapor deposition *Nano Lett.* **9** 30–5
[29] Liu L, Zhou H, Cheng R, Yu W J, Liu Y and Chen Y *et al* 2012 High-yield chemical vapor deposition growth of high-quality large-area AB-stacked bilayer graphene *ACS Nano.* **6** 8241–9

[30] Gomez T, Florez E, Rodriguez J A and Illas F 2011 Reactivity of transition metals (Pd, Pt, Cu, Ag, Au) toward molecular hydrogen dissociation: extended surfaces versus particles supported on TiC(001) or small is not always better and large is not always bad *J. Phys. Chem.* C **115** 11666–72
[31] Zhang X, Li H and Ding F 2014 Self-assembly of carbon atoms on transition metal surfaces—chemical vapor deposition growth mechanism of graphene *Adv. Mater.* **26** 5488–95
[32] Zhou Z, Habenicht B F and Guo Q 2013 Graphene Moiré structure grown on a pseudomorphic metal overlayer supported on Ru(0001) *Surf. Sci.* **611** 67–73
[33] Kim K S, Zhao Y, Jang H, Lee S Y, Kim J M and Kim K S *et al* 2009 Large-scale pattern growth of graphene films for stretchable transparent electrodes *Nature* **457** 706–10
[34] Li X, Cai W, An J, Kim S, Nah J and Yang D *et al* 2009 Large-area synthesis of high-quality and uniform graphene films on copper foils *Science* **324** 1312–4
[35] Zhou H, Yu W J, Liu L, Cheng R, Chen Y and Huang X *et al* 2013 Chemical vapour deposition growth of large single crystals of monolayer and bilayer graphene *Nat. Commun.* **4** 2096
[36] Su C Y, Lu A Y, Wu C Y, Li Y T, Liu K K and Zhang W *et al* 2011 Direct formation of wafer scale graphene thin layers on insulating substrates by chemical vapor deposition *Nano Lett.* **11** 3612–6
[37] Bae S, Kim H, Lee Y, Xu X, Park J S and Zheng Y *et al* 2010 Roll-to-roll production of 30-inch graphene films for transparent electrodes *Nat. Nanotechnol.* **5** 574–8
[38] Vijayaraghavan R K, Gaman C, Jose B, Mccoy A P, Cafolla T and McNally P J *et al* 2016 Pulsed-plasma physical vapor deposition approach toward the facile synthesis of multilayer and monolayer graphene for anticoagulation applications *ACS Appl. Mater. Interfaces* **8** 4878–86
[39] Wu X Y, Zhong G F, D'Arsie L, Sugime H, Esconjauregui S and Robertson A W *et al* 2016 Growth of continuous monolayer graphene with millimeter-sized domains using industrially safe conditions *Sci. Rep.* **6** 21152
[40] Bosca A, Pedros J, Martinez J, Palacios T and Calle F 2016 Automatic graphene transfer system for improved material quality and efficiency *Sci. Rep.* **6** 21676
[41] Engel M, Steiner M, Lombardo A, Ferrari A C, v. Lohneysen H and Avouris P *et al* 2012 Light matter interaction in a micro-cavity controlled graphene transistor *Nat. Commun.* **3** 906–11
[42] Koppens F H L, Mueller T, Avouris Ph, Ferrari A C, Vitiello M S and Polini M 2014 Photodetectors based on graphene, other two-dimensional materials and hybrid systems *Nat. Nanotechnol.* **9** 780–93
[43] Bonaccorso F, Sun Z, Hasan T and Ferrari A C 2010 Graphene photonics and optoelectronics *Nat. Photonics* **4** 611–22
[44] Khan F, Baek S H and Kim J H 2016 One-step and controllable bipolar doping of reduced graphene oxide using TMAH as reducing agent and doping source for field effect transistors *Carbon* **100** 608–16
[45] Kumar A, Tyagi P, Dagar J and Srivastava R 2016 Tunable field effect properties in solid state and flexible graphene electronics on composite high-low k dielectric *Carbon* **99** 579–84
[46] Tseng S F, Haiso W T, Cheng P Y, Chung C K, Lin Y S and Chien S C *et al* 2016 Graphene-based chips fabricated by ultraviolet laser patterning for an electrochemical impedance spectroscopy *Sens. Actuators B Chem.* **226** 342–8
[47] Liu J B, Li P J, Chen Y F, Song X B, Mao Q and Wu Y *et al* 2016 Flexible terahertz modulator based on coplanar-gate graphene field-effect transistor structure *Optics Lett.* **41** 816–9

[48] Shown I, Hsu H C, Chang Y, Lin C H, Roy P K and Ganguly A *et al* 2014 Highly efficient visible light photocatalytic reduction of CO_2 to hydrocarbon fuels by Cu-nanoparticle decorated graphene oxide *Nano Lett.* **14** 6097–103
[49] Hsu H C, Shown I, Wei H Y, Chang Y C, Du H Y and Lin Y G *et al* 2013 Graphene oxide as a promising photocatalyst for CO_2 to methanol conversion *Nanoscale* **5** 262–8
[50] Idier J, Neri W, Labrugere C, Ly I, Poulin P and Backov R 2016 Modified silver nanowire transparent electrodes with exceptional stability against oxidation *Nanotechnology* **27** 105705
[51] Koppens F H L, Chang D E and de Abajo F J G 2011 Graphene plasmonics: a platform for strong light-matter interactions *Nano Lett.* **11** 3370–7
[52] Matyba P, Yamaguchi H, Eda G, Chhowalla M, Edman L and Robinson N D 2010 Graphene and mobile ions: the key to all-plastic, solution-processed light-emitting devices *ACS Nano* **4** 637–42
[53] Kusumawati Y, Koussi-Daoud S and Pauporte T 2016 TiO_2/graphene nanocomposite layers for improving the performances of dye-sensitized solar cells using a cobalt redox shuttle *J. Photochem. Photobiol.* **329** 54–60
[54] Xia F N, Mueller T, Lin Y M, Valdes-Garcia A and Avouris P 2009 Ultrafast graphene photodetector *Nat. Nanotechnol.* **4** 839–43
[55] Mueller T, Xia F and Avouris P 2010 Graphene photodetectors for high-speed optical communications *Nat. Photon.* **4** 297–301
[56] Liu M, Yin X B, Ulin-Avila E, Geng B S, Zentgraf T and Ju L *et al* 2011 A graphene-based broadband optical modulator *Nature* **474** 64–7
[57] Xu P, Yang Y, Qi D, Barber S D, Schoelz J K and Ackerman M L *et al* 2012 Electronic transition from graphite to graphene via controlled movement of the top layer with scanning tunneling microscopy *Phys. Rev.* B **86** 085428
[58] Rong Z Y 1994 Extended modifications of electronic structures caused by defects: scanning tunneling microscopy of graphite *Phys. Rev.* B **50** 1839–43
[59] Pong W T, Bendall J and Durkan C 2007 Observation and investigation of graphite superlattice boundaries by scanning tunneling microscopy *Surf. Sci.* **601** 498
[60] Campanera J M, Savini G, Suarez-Martinez I and Heggie M I 2007 Density functional calculations on the intricacies of moiré patterns on graphite *Phys. Rev.* B **75** 235449
[61] Kazemi A S, Crampin S and Ilie A 2013 Stacking-dependent superstructures at stepped armchair interfaces of bilayer/trilayer graphene *Appl. Phys. Lett.* **102** 163111
[62] Biedermann L B, Bolen M L, Capano M A, Zemlyanov D and Reifenberger R G 2009 Insights into few-layer epitaxial graphene growth on 4H-SiC(000$\bar{1}$) substrates from STM studies *Phys. Rev.* B **79** 125411
[63] Que Y, Xiao W, Chen H, Wang D, Du S and Gao H J 2015 Stacking-dependent electronic property of trilayer graphene epitaxially grown on Ru(0001) *Appl. Phys. Lett.* **107** 263101
[64] Do T N, Lin C Y, Lin Y P, Shih P H and Lin M F 2015 Configuration-enriched magneto-electronic spectra of AAB-stacked trilayer graphene *Carbon* **94** 619–32
[65] Do T N, Shih P H, Chang C P, Lin C Y and Lin M F 2015 Rich magneto-absorption spectra in AAB-stacked trilayer graphene *Phys. Chem. Chem. Phys.* **18** 17597–605
[66] Huang Y K, Chen S C, Ho Y H, Lin C Y and Lin M F 2014 Feature-rich magnetic quantization in sliding bilayer graphenes *Sci. Rep.* **4** 7509
[67] Kindermann M and Mele E J 2011 Landau quantization in twisted bilayer graphene: the Dirac comb *Phys. Rev.* B **84** 161406

[68] Ohta T, Bostwick A and McChesney J L 2007 Interlayer interaction and electronic screening in multilayer graphene investigated with angle-resolved photoemission spectroscopy *Phys. Rev. Lett.* **98** 206802
[69] Moreau E, Godey S, Wallart X, Razado-Colambo I, Avila J and Asensio M C *et al* 2013 High-resolution angle-resolved photoemission spectroscopy study of monolayer and bilayer graphene on the C-face of SiC *Phys. Rev.* B **88** 075406
[70] Coletti C, Forti S, Principi A, Emtsev K V, Zakharov A A and Daniels K M *et al* 2013 Revealing the electronic band structure of trilayer graphene on SiC: an angle-resolved photoemission study *Phys. Rev.* B **88** 155439
[71] Pletikosić I, Kralj M, Pervan P, Brako R, Coraux J and N'Diaye A T *et al* 2009 Dirac cones and minigaps for graphene on Ir(111) *Phys. Rev. Lett.* **102** 056808
[72] Bostwick A, Ohta T, Seyller T, Horn K and Rotenberg E 2007 Quasiparticle dynamics in graphene *Nat. Phys.* **3** 36–40
[73] Emtsev K V, Speck F, Seyller T, Ley L and Riley J D 2008 Interaction, growth, and ordering of epitaxial graphene on SiC0001 surfaces: a comparative photoelectron spectroscopy study *Phys. Rev.* B **77** 155303
[74] Sprinkle M, Siegel D, Hu Y, Hicks J, Tejeda A and Taleb-Ibrahimi A *et al* 2009 First direct observation of a nearly ideal graphene band structure *Phys. Rev. Lett.* **103** 226803
[75] Zhang X, Han W P, Qiao X F, Tan Q H, Wang Y F and Zhang J *et al* 2016 Raman characterization of AB- and ABC-stacked few-layer graphene by interlayer shear modes *Carbon* **99** 118–22
[76] Raghavan S, Denig T J, Nelson T C, Chaudhari S and Stinespring C D 2016 Characterization of graphene-on-insulator films formed using plasma based surface chemistry *Carbon* **99** 212–21
[77] Wallace P R 1947 The band theory of graphite *Phys. Rev.* **71** 622–34
[78] Tsai S J, Chiu Y H, Ho Y H and Lin M F 2012 Gate-voltage-dependent Landau levels in AA-stacked bilayer graphene *Chem. Phys. Lett.* **550** 104–10
[79] Wang D and Jin G 2013 Tunneling magnetoresistance tuned by a vertical electric field in an AA-stacked graphene bilayer with double magnetic barriers *J. Appl. Phys.* **114** 233701
[80] Lobato I and Partoens B 2011 Multiple Dirac particles in AA-stacked graphite and multilayers of graphene *Phys. Rev.* B **83** 165429
[81] Lu C L, Chang C P, Huang Y C, Lu JM, Hwang C C and Lin M F 2006 Low-energy electronic properties of the AB-stacked few-layer graphites *J. Phys.: Condens. Matter* **18** 5849–59
[82] Gruneis A, Attaccalite C, Wirtz L, Shiozawa H, Saito R and Pichler T *et al* 2008 Tight-binding description of the quasiparticle dispersion of graphite and few-layer graphene *Phys. Rev.* B **78** 205425
[83] McCann E and Koshino M 2013 The electronic properties of bilayer graphene *Rep. Prog. Phys.* **76** 056503
[84] Partoens B and Peeters F M 2007 Normal and Dirac fermions in graphene multilayers: tight-binding description of the electronic structure *Phys. Rev.* B **75** 193402
[85] Luican A, Li G H, Reina A, Kong J, Nair R R and Novoselov K S *et al* 2011 Single-layer behavior and its breakdown in twisted graphene layers *Phys. Rev. Lett.* **106** 126802
[86] Kim K S, Walter A L, Moreschini L, Seyller T, Horn K and Rotenberg E *et al* 2013 Coexisting massive and massless Dirac fermions in symmetry-broken bilayer graphene *Nat. Mater.* **12** 887–92

[87] Li G H, Luican A, Lopes dos Santos J M B, Castro Neto A H, Reina A and Kong J *et al* 2010 Observation of van Hove singularities in twisted graphene layers *Nat. Phys.* **6** 109–13
[88] Goto H, Uesugi E, Eguchi R and Kubozono Y 2013 Parity effects in few-layer graphene *Nano Lett.* **3** 5153–8
[89] Latil S, Meunier V and Henrard L 2007 Massless fermions in multilayer graphitic systems with misoriented layers: *ab initio* calculations and experimental fingerprints *Phys. Rev.* B **76** 201402 (R)
[90] Koshino M and McCann E 2010 Parity and valley degeneracy in multilayer graphene *Phys. Rev.* B **81** 115315
[91] Maka K F, Sfeirb M Y, Misewichb J A and Heinza T F 2010 The evolution of electronic structure in few-layer graphene revealed by optical spectroscopy *Proc. Natl Acad. Sci. USA.* **107** 14999–15004
[92] Yan X Z and Ting C S 2015 Current orderings of interacting electrons in bilayer graphene *Phys. Rev.* B **92** 075442
[93] Castro Neto A H, Guinea F, Peres N M R, Novoselov K S and Geim A K 2009 The electronic properties of graphene *Rev. Mod. Phys.* **81** 109–162
[94] Latil S and Henrard L 2006 Charge carriers in few-layer graphene films *Phys. Rev. Lett.* **97** 036803
[95] Zhang F, Sahu B, Min H and MacDonald A H 2010 Band structure of ABC-stacked graphene trilayers *Phys. Rev.* B **82** 035409
[96] Xiao R, Tasnadi F, Koepernik K, Venderbos J W F, Richter M and Taut M 2011 Density functional investigation of rhombohedral stacks of graphene: topological surface states, nonlinear dielectric response, and bulk limit *Phys. Rev.* B **84** 165404
[97] Guinea F, Castro Neto A H and Peres N M R 2006 Electronic states and Landau levels in graphene stacks *Phys. Rev.* B **73** 245426
[98] Wang H, Gao J H and Zhang F C 2013 Flat band electrons and interactions in rhombohedral trilayer graphene *Phys. Rev.* B **87** 155116
[99] Kopnin N B, Heikkila T T and Volovik G E 2011 High-temperature surface superconductivity in topological flat-band systems *Phys. Rev.* B **83** 220503
[100] Lu C L, Chang C P, Huang Y C, Chen R B and Lin M L 2006 Influence of an electric field on the optical properties of few-layer graphene with AB stacking *Phys. Rev.* B **73** 144427
[101] Lu C L, Chang C P, Huang Y C, Ho J H, Hwang C C and Lin M F 2007 Electronic properties of AA- and ABC-stacked few-layer graphites *J. Phys. Soc. Jap.* **76** 024701
[102] McCann E 2006 Asymmetry gap in the electronic band structure of bilayer graphene *Phys. Rev.* B **74** 161403
[103] Min H, Sahu B, Banerjee S K and MacDonald A H 2007 *Ab initio* theory of gate induced gaps in graphene bilayers *Phys. Rev.* B **75** 155115
[104] Kumar S B and Guo J 2011 Multilayer graphene under vertical electric field *App. Phy. Lett.* **98** 222101
[105] Wu B R 2011 Field modulation of the electronic structure of trilayer graphene *App. Phy. Lett.* **98** 263107
[106] Avetisyan A A, Partoens B and Peeters F M 2009 Electric field tuning of the band gap in graphene multilayers *Phys. Rev.* B **79** 035421
[107] Castro E V, Novoselov K S, Morozov S V, Peres N M R, Lopes dos Santos J M B and Nilsson J *et al* 2007 Biased bilayer graphene: semiconductor with a gap tunable by the electric field effect *Phys. Rev. Lett.* **99** 216802

[108] Yankowitz M, Wang F L, Lau C N and LeRoy B J 2013 Local spectroscopy of the electrically tunable band gap in trilayer graphene *Phys. Rev.* B **87** 165102
[109] Zhang Y, Tang T T, Girit C, Hao Z, Martin M C and Zettl A *et al* 2009 Direct observation of a widely tunable bandgap in bilayer graphene *Nature* **459** 820–3
[110] Lui C H, Li Z, Mak K F, Cappelluti E and Heinz T F 2011 Observation of an electrically tunable band gap in trilayer graphene *Nat. Phys.* **7** 944–7
[111] Taisuke O, Aaron B and Thomas S 2006 Controlling the electronic structure of bilayer graphene *Science* **313** 951–4
[112] Bao W, Jing L, Velasco J, Lee Y, Liu G and Tran D *et al* 2011 Stacking-dependent band gap and quantum transport in trilayer graphene *Nat. Phys.* **7** 948–52
[113] Wang F, Zhang Y, Tian C, Girit C, Zettl A and Crommie M *et al* 2008 Gate-variable optical transitions in graphene *Science* **320** 206–9
[114] Craciun M F, Russo S, Yamamoto M, Oostinga J B, Morpurgo A F and Tarucha S 2009 Trilayer graphene is a semimetal with a gate-tunable band overlap *Nat. Nanotechnol.* **4** 383–8
[115] Zhang W, Lin C T, Liu K K, Tite T, Su C Y and Chang C H *et al* 2011 Opening electrical band gap of bilayer graphene with molecular doping *ACS Nano.* **5** 7517–24
[116] Lee C, Kim J, Kim S, Chang Y J, Kim K S and Hong B *et al* 2016 Strong hole-doping and robust resistance-decrease in proton-irradiated graphene *Sci. Rep.* **6** 21311
[117] Liu H, Liu Y and Zhu D 2011 Chemical doping of graphene *J. Mater. Chem.* **21** 3335–45
[118] Wei D, Liu Y, Wang Y, Zhang H, Huang L and Yu G 2009 Synthesis of N-doped graphene by chemical vapor deposition and its electrical properties *Nano Lett.* **9** 1752–8
[119] Nakada K and Ishii A 2011 Migration of adatom adsorption on graphene using DFT calculation *Solid State Commun.* **151** 13–6
[120] Rana M, Arora G and Gautam U K 2015 N- and S-doped high surface area carbon derived from soya chunks as scalable and efficient electrocatalysts for oxygen reduction *Sci. Technol. Adv. Mat.* **16** 014803
[121] Lin Y P, Ksari Y, Aubel D, Hajjar-Garreau S, Borvon G and Spiegel Y *et al* 2016 Efficient and low-damage nitrogen doping of graphene via plasma-based methods *Carbon* **100** 337–44
[122] Arjmand M, Chizari K, Krause B, Potschke P and Sundararaj U 2016 Effect of synthesis catalyst on structure of nitrogen-doped carbon nanotubes and electrical conductivity and electromagnetic interference shielding of their polymeric nanocomposites *Carbon* **98** 358–72
[123] Raquet B, Avriller R, Lassagne B, Nanot S, Escoffier W and Broto JM *et al* 2008 Onset of Landau-level formation in carbon-nanotube-based electronic Fabry-Pérot resonators *Phys. Rev. Lett.* **101** 046803
[124] Chang C P, Lu C L, Shyu F L, Chen R B, Fang Y K and Lin M F 2004 Magnetoelectronic properties of a graphite sheet *Carbon* **42** 2975–80
[125] Ho J H, Lai Y H, Chiu Y H and Lin M F 2008 Landau levels in graphene *Physica* E **40** 1722–5
[126] Lin C Y, Wu J Y, Ou Y J, Chiu Y H and Lin M F 2015 Magneto-electronic properties of multilayer graphenes *Phys. Chem. Chem. Phys.* **17** 26008–35
[127] Chang C P 2011 Exact solution of the spectrum and magneto-optics of multilayer hexagonal graphene *J. Appl. Phys.* **110** 013725
[128] Lai Y H, Ho J H, Chang C P and Lin M F 2008 Magnetoelectronic properties of bilayer bernal graphene *Phys. Rev.* B **77** 085426
[129] McCann E and Fal'ko V I 2006 Landau-level degeneracy and quantum Hall effect in a graphite bilayer *Phys. Rev. Lett.* **96** 086805

[130] Min H and MacDonald A H 2008 Chiral decomposition in the electronic structure of graphene multilayers *Phys. Rev.* B **77** 155416
[131] Koshino M and McCann E 2011 Landau level spectra and the quantum Hall effect of multilayer graphene *Phys. Rev.* B **83** 165443
[132] Min H and MacDonald A H 2008 Electronic structure of multilayer graphene *Prog. Theor. Phys. Supplement* **176** 227–52
[133] Aoki M and Amawash H 2007 Dependence of band structures on stacking and field in layered graphene *Solid State Commun.* **142** 123–7
[134] Avetisyan A A, Partoens B and Peeters F M 2010 Stacking order dependent electric field tuning of the band gap in graphene multilayers *Phys. Rev.* B **81** 115432
[135] Koshino M and McCann E 2009 Gate-induced interlayer asymmetry in ABA-stacked trilayer graphene *Phys. Rev.* B **79** 125443
[136] Kim D S, Kwon H, Nikitin A Y, Ahn S, Martin-Moreno L and Garcia-Vidal F J *et al* 2015 Stacking structures of few-layer graphene revealed by phase-sensitive infrared nanoscopy *ACS Nano* **9** 6765–73
[137] Cadden-Zimansky P, Jiang Z, Li Z Q, Tung L C, Schwartz M E and Takita M *et al* 2010 Interaction-induced shift of the cyclotron resonance of graphene using infrared spectroscopy *Phys. Rev. Lett.* **104** 067404
[138] Faugeras C, Amado M, Kossacki P, Orlita M, Kuhne M and Nicolet A A L *et al* 2011 Magneto-Raman scattering of graphene on graphite: electronic and phonon excitations *Phys. Rev. Lett.* **107** 036807
[139] Zhao H M, Lin Y C, Yeh C H, Tian H, Chen Y C and Xie D *et al* 2014 Growth and raman spectra of single-crystal trilayer graphene with different stacking orientations *ACS Nano.* **8** 10766–73
[140] Cong C X, Jung J, Cao B C, Qiu C Y, Shen X N and Ferreira A *et al* 2015 Magnetic oscillation of optical phonon in ABA- and ABC-stacked trilayer graphene *Phys. Rev.* B **91** 235403
[141] Sena S H R, Pereira J M, Peeters F M and Farias G A 2011 Landau levels in asymmetric graphene trilayers *Phys. Rev.* B **84** 205448
[142] Yuan S, Roldan R and Katsnelson M I 2011 Landau level spectrum of ABA- and ABC-stacked trilayer graphene *Phys. Rev.* B **84** 125455
[143] Ho C H, Tsai S J, Chen R B, Chiu Y H and Lin M F 2011 Low-energy Landau level spectrum in ABC-stacked trilayer graphene *J. Nanosci. Nanotechnol.* **11** 4938–47
[144] Ho C H, Ho Y H, Chiu Y H, Chen Y N and Lin M F 2011 Magneto-electronic properties of rhombohedral trilayer graphene: Peierls tight-binding model *Ann. Phys.* **326** 721–39
[145] Koshino M and McCann E 2009 Trigonal warping and Berry's phase $N\pi$ in ABC-stacked multilayer graphene *Phy. Rev.* B **80** 165409
[146] Lin C Y, Wu J Y, Chiu Y H, Chang C P and Lin M F 2014 Stacking-dependent magnetoelectronic properties in multilayer graphene *Phys. Rev.* B **90** 205434
[147] Lin Y P, Wang J, Lu J M, Lin C Y and Lin M F 2014 Energy spectra of ABC-stacked trilayer graphene in magnetic and electric fields *RSC Adv.* **4** 56552–60
[148] Tran N T T, Lin S Y, Glukhova O E and Lin M F 2015 Configuration-induced rich electronic properties of bilayer graphene *J Phys. Chem.* C **119** 10623–30
[149] Inoue M 1962 Landau levels and cyclotron resonance in graphite *J. Phys. Soc. Jpn* **17** 808
[150] Ou Y C, Sheu J K, Chiu Y H, Chen R B and Lin M F 2011 Influence of modulated fields on the Landau level properties of graphene *Phys. Rev.* B **83** 195405

[151] Chiu Y H, Ou Y C, Liao Y Y and Lin M F 2010 Optical-absorption spectra of single-layer graphene in a periodic magnetic field *J. Vac. Sci. Technol.* B **28** 386–90
[152] Ou Y C, Chiu Y H, Yang P H and Lin M F 2014 The selection rule of graphene in a composite magnetic field *Opti. Express* **22** 7473–91
[153] Chiu C W, Chen S C, Huang Y C, Shyu F L and Lin M F 2013 Critical optical properties of AA-stacked multilayer graphenes *Appl. Phys. Lett.* **103** 041907
[154] Lee S H, Ho Y H, Chiu C W and Lin M F 2010 Optical properties of deformed few-layer graphenes with AB stacking *J. Appl. Phys.* **108** 043509
[155] Kadi F and Malic E 2014 Optical properties of bernal-stacked bilayer graphene: a theoretical study *Phys. Rev.* B **89** 045419
[156] Koshino M 2013 Stacking-dependent optical absorption in multilayer graphene *New J. Phys.* **15** 015010
[157] Chiu C W, Ho Y H, Shyu F L and Lin M F 2014 Layer-enriched optical spectra of AB-stacked multilayer graphene *App. Phys. Express* **7** 115102
[158] Ho Y H, Chiu Y H, Lin D H, Chang C P and Lin M F 2010 Magneto-optical selection rules in bilayer Bernal graphene *ACS Nano* **4** 1465–72
[159] Abergel D S L and Fal'ko V I 2007 Optical and magneto-optical far-infrared properties of bilayer graphene *Phys. Rev.* B **75** 155430
[160] Chiu C W, Huang Y C, Shyu F L and Lin M F 2012 Optical absorption spectra in ABC-stacked graphene superlattice *Synthetic Met.* **162** 800–4
[161] Yan J A, Ruan W Y and Chou M Y 2011 Enhanced optical conductivity induced by surface states in ABC-stacked few-layer graphene *Phys. Rev.* B **83** 245418
[162] Lin C Y, Wu J Y, Chang C P and Lin M F 2014 Magneto-optical selection rules of curved graphene nanoribbons and carbon nanotubes *Carbon* **69** 151–61
[163] Gusynin V P and Sharapov S G 2006 Transport of Dirac quasiparticles in graphene: Hall and optical conductivities *Phys. Rev.* B **73** 245411
[164] Gusynin V P, Sharapov S G and Carbotte J P 2007 Anomalous absorption line in the magneto-optical response of graphene *Phys. Rev. Lett.* **98** 157402
[165] Koshino M and Ando T 2008 Magneto-optical properties of multilayer graphene *Phy. Rev.* B **77** 115313
[166] Li Z Q, Henriksen E A, Jiang Z, Hao Z, Martin M C and Kim P *et al* 2008 Dirac charge dynamics in graphene by infrared spectroscopy *Nat. Phys.* **4** 532–5
[167] Zhang L M, Li Z Q, Basov D N, Fogler M M, Hao Z and Martin M C 2008 Determination of the electronic structure of bilayer graphene from infrared spectroscopy *Phys. Rev.* B **78** 235408
[168] Kuzmenko A B, van Heumen E, van der Marel D, Lerch P, Blake P and Novoselov K S *et al* 2009 Infrared spectroscopy of electronic bands in bilayer graphene *Phys. Rev.* B **79** 115441
[169] Faugeras C, Berciaud S, Leszczynski P, Henni Y, Nogajewski K and Orlita M *et al* 2015 Landau level spectroscopy of electron–electron interactions in graphene *Phys. Rev. Lett.* **114** 126804
[170] Orlita M, Faugeras C, Barra A L, Martinez G, Potemski M and Basko D M *et al* 2015 Infrared magneto-spectroscopy of two-dimensional and three-dimensional massless fermions: a comparison *J. Appl. Phys.* **117** 112803
[171] Berciaud S, Potemski M and Faugeras C 2014 Probing electronic excitations in mono- to pentalayer graphene by micro magneto-Raman spectroscopy *Nano Lett.* **14** 4548–53

[172] Faugeras C, Binder J, Nicolet A A L, Leszczynski P, Kossacki P and Wysmolek A *et al* 2014 A micro-magneto-Raman scattering study of graphene on a bulk graphite substrate *EPL* **108** 27011
[173] Li Z Q, Henriksen E A, Jiang Z, Hao Z, Martin M C and Kim P *et al* 2009 Band structure asymmetry of bilayer graphene revealed by infrared spectroscopy *Phys. Rev. Lett.* **102** 037403
[174] Mak K F, Shan J and Heinz T F 2010 Electronic structure of few-layer graphene: experimental demonstration of strong dependence on stacking sequence *Phys. Rev. Lett.* **104** 176404
[175] Lin Y P, Lin C Y, Ho Y H, Do T N and Lin M F 2015 Magneto-optical properties of ABC-stacked trilayer graphene *Phys. Chem. Chem. Phys.* **17** 15921–7
[176] Lin Y P, Lin C Y, Chang C P and Lin M F 2015 Electric-field-induced rich magneto-absorption spectra of ABC-stacked trilayer graphene *RSC Adv.* **5** 80410
[177] Jiang Z, Henriksen E A, Tung L C, Wang Y J, Schwartz M E and Han M Y *et al* 2007 Infrared spectroscopy of Landau levels of graphene *Phys. Rev. Lett.* **98** 197403
[178] Kuhne P, Darakchieva V, Yakimova R, Tedesco J D, Myers-Ward R L and Eddy C R *et al* 2013 Polarization selection rules for inter-Landau-level transitions in epitaxial graphene revealed by the infrared optical Hall effect *Phys. Rev. Lett.* **111** 077402
[179] Orlita M, Faugeras C, Plochocka P, Neugebauer P, Martinez G and Maude D K *et al* 2008 Approaching the Dirac point in high-mobility multilayer epitaxial graphene *Phys. Rev. Lett.* **101** 267601
[180] Plochocka P, Faugeras C, Orlita M, Sadowski M L, Martinez G and Potemski M *et al* 2008 High-energy limit of massless Dirac fermions in multilayer graphene using magneto-optical transmission spectroscopy *Phys. Rev. Lett.* **100** 087401
[181] Daboussi A, Mandhour L, Fuchs J N and Jaziri S 2014 Tunable zero-energy transmission resonances in shifted graphene bilayer *Phys. Rev.* B **89** 085426
[182] Pedersen J G and Pedersen T G 2011 Tight-binding study of the magneto-optical properties of gapped graphene *Phys. Rev.* B **84** 115424
[183] Ho Y H, Wu J Y, Chen R B and Lin M F 2010 Optical transitions between Landau levels: AA-stacked bilayer graphene *App. Phys. Lett.* **97** 101905
[184] Orlita M, Faugeras C, Borysiuk J, Baranowski J M, Strupiński W and Sprinkle M *et al* 2011 Magneto-optics of bilayer inclusions in multilayered epitaxial graphene on the carbon face of SiC *Phys. Rev.* B **83** 125302
[185] Orlita M, Faugeras C, Schneider JM, Martinez G, Maude D K and Potemski M 2009 Graphite from the viewpoint of Landau level spectroscopy: an effective graphene bilayer and monolayer *Phys. Rev. Lett.* **102** 166401
[186] Henriksen E A, Jiang Z, Tung L C, Schwartz M E, Takita M and Wang Y J *et al* 2008 Cyclotron resonance in bilayer graphene *Phys. Rev. Lett.* **100** 087403
[187] Ellis C T, Stier A V, Kim M H, Tischler J G, Glaser E R and Myers-Ward R L *et al* 2013 Magneto-optical fingerprints of distinct graphene multilayers using the giant infrared Kerr effect *Sci. Rep.* **3** 3143
[188] Tung L C, Cadden-Zimansky P, Qi J, Jiang Z and Smirnov D 2011 Measurement of graphite tight-binding parameters using high-field magnetoreflectance *Phys. Rev.* B **84** 153405
[189] Plochocka P, Solane P Y, Nicholas R J, Schneider J M, Piot B A and Maude D K *et al* 2012 Origin of electron-hole asymmetry in graphite and graphene *Phys. Rev.* B **85** 245410

[190] Ho J H, Lu C L, Hwang C C, Chang C P and Lin M F 2006 Coulomb excitations in AA- and AB-stacked bilayer graphites *Phys. Rev.* B **74** 085406
[191] Ho J H, Chang C P and Lin M F 2005 Electronic excitations of the multilayered graphite *Phys. Lett.* A **352** 446–50
[192] Lin M F, Chuang Y C and Wu J Y 2012 Electrically tunable plasma excitations in AA-stacked multilayer graphene *Phys. Rev.* B **86** 125434
[193] Wu J Y, Chen S C, Roslyak O, Gumbs G and Lin M F 2011 Plasma excitations in graphene: their spectral intensity and temperature dependence in magnetic field *ACS Nano* **5** 1026–32
[194] Lozovik Y E and Sokolik A A 2012 Influence of Landau level mixing on the properties of elementary excitations in graphene in strong magnetic field *Nano Res. Lett.* **7** 134
[195] Wu J Y, Gumbs G and Lin M F 2014 Combined effect of stacking and magnetic field on plasmon excitations in bilayer graphene *Phys. Rev.* B **89** 165407
[196] Wu J Y, Lin C Y, Gumbs G and Lin M F 2015 The effect of perpendicular electric field on temperature-induced plasmon excitations for intrinsic silicene *RSC Adv.* **5** 51912–8
[197] Yuan S, Roldan R and Katsnelson M I 2011 Excitation spectrum and high-energy plasmons in single-layer and multilayer graphene *Phys. Rev.* B **84** 035439
[198] Wang W, Kinaret J M and Apell S P 2012 Excitation of edge magnetoplasmons in semi-infinite graphene sheets: temperature effects *Phys. Rev.* B **85** 235444
[199] Roldan R, Fuchs J N and Goerbig M O 2009 Collective modes of doped graphene and a standard two-dimensional electron gas in a strong magnetic field: linear magnetoplasmons versus magnetoexcitons *Phys. Rev.* B **80** 085408
[200] Roldan R and Brey L 2013 Dielectric screening and plasmons in AA-stacked bilayer graphene *Phy. Rev.* B **88** 115420
[201] Gumbs G and Huang D 2007 Electronically modulated two-dimensional plasmons coupled to surface plasmon modes *Phys. Rev.* B **75** 115314
[202] Roslyak O, Gumbs G and Huang D 2011 Plasma excitations of dressed Dirac electrons in graphene layers *J. Appl. Phys.* **109** 113721
[203] Geim A K and Novoselov K S 2007 The rise of graphene *Nat. Mater.* **6** 183–91
[204] Novoselov K S, Geim A K, Morozov S V, Jiang D, Katsnelson M I and Grigorieva I V *et al* 2005 Two-dimensional gas of massless Dirac fermions in graphene *Nature* **438** 197–200
[205] Hao Y, Bharathi M S, Wang L, Liu Y, Chen H and Nie S *et al* 2013 The role of surface oxygen in the growth of large single-crystal graphene on copper *Science* **342** 720–3
[206] Chen J H, Jang C, Xiao S, Ishigami M and Fuhrer M S 2008 Intrinsic and extrinsic performance limits of graphene devices on SiO_2 *Nat. Nanotechnol.* **3** 206–9
[207] Morozov S V, Novoselov K S, Katsnelson M I, Schedin F, Elias D C and Jaszczak J A *et al* 2008 Giant intrinsic carrier mobilities in graphene and its bilayer *Phys. Rev. Lett.* **100** 016602
[208] Pallecchi E, Lafont F, Cavaliere V, Schopfer F, Mailly D and Poirier W *et al* 2014 High electron mobility in epitaxial graphene on 4H-SiC(0001) via post-growth annealing under hydrogen *Sci. Rep.* **4** 4558
[209] Schwierz F 2010 Graphene transistors *Nat. Nanotechnol.* **5** 487–96
[210] Gusynin V P and Sharapov S G 2005 Unconventional integer quantum Hall effect *Phys. Rev. Lett.* **95** 146801
[211] Zhang Y B, Tan Y W, Stormer H L and Kim P 2005 Experimental observation of the quantum Hall effect and Berry's phase in graphene *Nature* **438** 201–4

[212] Novoselov K S, Jiang Z, Zhang Y, Morozov S V, Stormer H L and Zeitler U *et al* 2007 Room-temperature quantum Hall effect in graphene *Science* **315** 1379–9
[213] Hsu Y F and Guo G Y 2010 Anomalous integer quantum Hall effect in AA-stacked bilayer graphene *Phys. Rev.* B **82** 165404
[214] Novoselov K S, McCann E, Morozov S V, Fal'ko V I, Katsnelson M I and Zeitler U *et al* 2006 Unconventional quantum Hall effect and Berry's phase of 2π in bilayer graphene *Nat. Phys.* **2** 177–80
[215] Oostinga J B, Heersche H B, Liu X, Morpurgo A F and Vandersypen L M K 2008 Gate-induced insulating state in bilayer graphene devices *Nat. Mater.* **7** 151–7
[216] Taychatanapat T, Watanabe K, Taniguchi T and Jarillo-Herrero P 2008 Quantum Hall effect and Landau-level crossing of Dirac fermions in trilayer graphene *Nat. Phys.* **7** 621–5
[217] van Elferen H J, Veligura A, Tombros N, Kurganova E V, van Wees B J and Maan J C *et al* 2013 Fine structure of the lowest Landau level in suspended trilayer graphene *Phys. Rev.* B **88** 121302
[218] Kumar A, Escoffier W, Poumirol J M, Faugeras C, Arovas D P and Fogler M M *et al* 2011 Integer quantum Hall effect in trilayer graphene *Phys. Rev. Lett.* **107** 126806
[219] Zhang L, Zhang Y, Camacho J, Khodas M and Zaliznyak I 2011 The experimental observation of quantum Hall effect of $l = 3$ chiral quasiparticles in trilayer graphene *Nat. Phys.* **7** 953–7
[220] Lee Y, Velasco J, Tran D, Zhang F, Bao W and Jing L *et al* 2013 Broken symmetry quantum Hall states in dual-gated ABA trilayer graphene *Nano Lett.* **13** 1627–31
[221] Henriksen E A, Nandi D and Eisenstein J P 2012 Quantum Hall effect and semimetallic behavior of dual-gated ABA-stacked trilayer graphene *Phys. Rev.* X **2** 011004
[222] Foa Torres L E F, Perez-Piskunow P M, Balseiro C A and Usaj G 2014 Multiterminal conductance of a Floquet topological insulator *Phys. Rev. Lett.* **113** 266801
[223] Ezawa M 2012 A topological insulator and helical zero mode in silicene under an inhomogeneous electric field *New J. Phys.* **14** 033003
[224] Ezawa M 2012 Valley-polarized metals and quantum anomalous Hall effect in silicene *Phys. Rev. Lett.* **109** 055502
[225] Tai Y Y, Choi H C, Ahmed T, Ting C S and Zhu J X 2015 Edge states and local electronic structure around an adsorbed impurity in a topological superconductor *Phys. Rev.* B **92** 174514
[226] Li M Y, Shi Y, Cheng C C, Lu L S, Lin Y C and Tang H L *et al* 2015 Epitaxial growth of a monolayer WSe_2-MoS_2 lateral p-n junction with an atomically sharp interface science **349** 524–58
[227] Ho Y H, Wang Y H and Chen H Y 2014 Magnetoelectronic and optical properties of a MoS_2 monolayer *Phys. Rev.* B **89** 155316
[228] Ho Y H, Chiu C W and Lin M F 2014 Magneto-optical spectra of transition metal dichalcogenides: a comparative study *Appl. Phys. Lett.* **105** 222411
[229] Tabert C J and Nicol E J 2013 Valley-spin polarization in the magneto-optical response of silicene and other similar 2D crystals *Phys. Rev. Lett.* **110** 197402
[230] Tabert C J and Nicol E J 2013 Magneto-optical conductivity of silicene and other buckled honeycomb lattices *Phys. Rev.* B **88** 085434
[231] Schafgans A A, Post K W, Taskin A A, Ando Y, Qi X L and Chapler B C *et al* 2012 Landau level spectroscopy of surface states in the topological insulator $Bi_{0.91}Sb_{0.09}$ via magneto-optics *Phys. Rev.* B **85** 195440

[232] LaForge A D, Frenzel A, Pursley B C, Lin T, Liu X F and Shi J *et al* 2010 Optical characterization of Bi_2Se_3 in a magnetic field: infrared evidence for magnetoelectric coupling in a topological insulator material *Phys. Rev.* B **81** 125120
[233] Morkoc H, Strite S, Gao G B, Lin M E, Sverdlov B and Burns M 1994 Large-band-gap SiC, III–V nitride, and II–VI ZnSe-based semiconductor-device technologies *J. Appl. Phys.* **76** 1363–98
[234] Ando T, Fowler A B and Stern F 1982 Electronic properties of two-dimensional systems *Rev. Mod. Phys.* **54** 437–72
[235] Hendry E, Hale P J, Moger J, Savchenko A K and Mikhailov S A 2010 Coherent nonlinear optical response of graphene *Phys. Rev. Lett.* **105** 097401
[236] Ferrari A C, Meyer J C, Scardaci V, Casiraghi C, Lazzeri M and Mauri F *et al* 2006 Raman spectrum of graphene and graphene layers *Phys. Rev. Lett.* **97** 187401
[237] Nyakiti L O, Myers-Ward R L, Wheeler V D, Imhoff E A, Bezares F J and Chun H *et al* 2012 Bilayer graphene grown on 4H-SiC (0001) step-free mesas *Nano Lett.* **12** 1749–56
[238] Lui C H, Li Z, Chen Z, Klimov P V, Brus L E and Heinz T F 2011 Imaging stacking order in few-layer graphene *Nano Lett.* **11** 164–9
[239] Cancado L G, Takai K, Enoki T, Endo M, Kim Y A and Mizusaki H *et al* 2008 Measuring the degree of stacking order in graphite by raman spectroscopy *Carbon* **46** 272–5
[240] Fang W, Hsu A L, Caudillo R, Song Y, Birdwell A G and Zakar E *et al* 2013 Rapid identification of stacking orientation in isotopically labeled chemical-vapor grown bilayer graphene by raman spectroscopy *Nano Lett.* **13** 1541–8
[241] Poncharal P, Ayari A, Michel T and Sauvajol J L 2008 Raman spectra of misoriented bilayer graphene *Phys. Rev.* B **78** 113407
[242] Malard L M, Nilsson J, Elias D C, Brant J C, Plentz F and Alves E S *et al* 2007 Probing the electronic structure of bilayer graphene by Raman scattering *Phys. Rev.* B **76** 201401
[243] Xie L M, Wang H L, Jin C H, Wang X R, Jiao L Y and Suenaga K *et al* 2011 Graphene nanoribbons from unzipped carbon nanotubes: atomic structures, Raman spectroscopy, and electrical properties *J. Am. Chem. Soc.* **133** 10394–7
[244] Matsui T, Kambara H, Niimi Y, Tagami K, Tsukada M and Fukuyama H 2005 STS observations of Landau levels at graphite surfaces *Phys. Rev.* B **94** 226403
[245] Uchoa B, Yang L, Tsai S W, Peres N M and Castro Neto A H 2009 Theory of scanning tunneling spectroscopy of magnetic adatoms in graphene *Phys. Rev. Lett.* **103** 206804
[246] Miller D L, Kubista K D, Rutter G M, Ruan M, de Heer W A and First P N *et al* 2009 Observing the quantization of zero mass carriers in graphene *Science* **324** 924–7
[247] Song Y J, Otte A F, Kuk Y, Hu Y, Torrance D B and First P N *et al* 2010 High-resolution tunnelling spectroscopy of a graphene quartet *Nature* **467** 185–9
[248] Jung S, Rutter G M, Klimov N N, Newell D B, Calizo I and Hight-Walker AR *et al* 2011 Evolution of microscopic localization in graphene in a magnetic field from scattering resonances to quantum dots *Nat. Phys.* **7** 245–51
[249] Chae J, Jung S, Young A F, Dean C R, Wang L and Gao Y *et al* 2012 Renormalization of the graphene dispersion velocity determined from scanning tunneling spectroscopy *Phys. Rev. Lett.* **109** 116802
[250] Li G, Luican A and Andrei E Y 2009 Scanning tunneling spectroscopy of graphene on graphite *Phys. Rev. Lett.* **102** 176804
[251] Rutter G M, Jung S, Klimov N N, Newell D B, Zhitenev N B and Stroscio J A 2011 Microscopic polarization in bilayer graphene *Nat. Phys.* **7** 649–55

[252] Miller D L, Kubista K D, Rutter G M, Ruan M, de Heer W A and Kindermann M *et al* 2010 Real-space mapping of magnetically quantized graphene states *Nat. Phys.* **6** 811–7
[253] Hashimoto K, Champel T, Florens S, Sohrmann C, Wiebe J and Hirayama Y *et al* 2012 Robust nodal structure of Landau level wave functions revealed by Fourier transform scanning tunneling spectroscopy *Phys. Rev. Lett.* **109** 116805
[254] Fu Y S, Kawamura M, Igarashi K, Takagi H, Hanaguri T and Sasagawa T 2014 Imaging the two-component nature of Dirac–Landau levels in the topological surface state of Bi_2Se_3 *Nat. Phys.* **10** 815–9
[255] Chang C P, Lu C L, Shyu F L, Chen R B, Huang Y C and Lin M F 2005 Magnetoelectronic properties of AB-stacked graphite *Carbon* **43** 1424–31
[256] Lu C L, Chang C P and Lin M F 2007 Magneto-electronic properties of AA- and ABC-stacked graphites *Eur. Phys. J.* B **60** 161–9

Full list of references

Chapter 1

[1] Novoselov K S, Geim A K, Morozov S V, Jiang D, Zhang Y and Dubonos S V *et al* 2004 Electric field effect in atomically thin carbon films *Science* **306** 666–9

[2] Novoselov K S, Jiang D, Schedin F, Booth T J, Khotkevich V V and Morozov S V *et al* 2005 Two-dimensional atomic crystals *Proc. Natl Acad. Sci. USA.* **102** 10451–3

[3] Lee J K, Lee S C, Ahn J P, Kim S C, Wilson J I B and John P 2008 The growth of AA graphite on (1 1 1) diamond *J. Chem. Phys.* **129** 234709

[4] Liu Z, Suenaga K, Harris P J F and Iijima S 2009 Open and closed edges of graphene layers *Phys. Rev. Lett.* **102** 015501

[5] Borysiuk J, Soltys J and Piechota J 2011 Stacking sequence dependence of graphene layers on SiC (000-1)—experimental and theoretical investigation *J. Appl. Phys.* **109** 093523

[6] Cherkez V, Trambly de Laissardiere G, Mallet P and Veuillen J Y 2015 Van Hove singularities in doped twisted graphene bilayers studied by scanning tunneling spectroscopy *Phys. Rev.* B **91** 155428

[7] Yan W, Liu M, Dou R F, Meng L, Feng L and Chu Z D *et al* 2012 Angle-dependent van Hove singularities in a slightly twisted graphene bilayer *Phys. Rev. Lett.* **109** 126801

[8] Lauffer P, Emtsev K V, Graupner R, Seyller Th, Ley L and Reshanov S A *et al* 2008 Atomic and electronic structure of few-layer graphene on SiC(0001) studied with scanning tunneling microscopy and spectroscopy *Phys. Rev.* B **77** 155426

[9] Hattendorf S, Georgi A, Liebmann M and Morgenstern M 2013 Networks of ABA and ABC stacked graphene on mica observed by scanning tunneling microscopy *Surf. Sci.* **610** 53–8

[10] Norimatsu W and Kusunoki M 2010 Selective formation of ABC-stacked graphene layers on SiC(0001) *Phys. Rev.* B **81** 161410

[11] Warner J H, Mukai M and KirklandA I 2012 Atomic structure of ABC rhombohedral stacked trilayer graphene *ACS Nano.* **6** 5680–6

[12] Rong Z Y and Kuiper P 1993 Electronic effects in scanning tunneling microscopy: moiré pattern on a graphite surface *Phys. Rev.* B **48** 17427

[13] Campanera J M, Savini G, Suarez-Martinez I and Heggie M I 2007 Density functional calculations on the intricacies of moiré patterns on graphite *Phys. Rev.* B **75** 235449

[14] Biedermann L B, Bolen M L, Capano M A, Zemlyanov D and Reifenberger R G 2009 Insights into few-layer epitaxial graphene growth on 4H-SiC substrates from STM studies *Phys. Rev.* B **79** 125411

[15] Bernal J D 1924 The structure of graphite *Proc. R. Soc. London, Ser.* A **106** 749

[16] Lipson H and Stokes A R 1942 The structure of graphite *Proc. R. Sot. London, Ser.* A **181** 101

[17] Charlier J C, Gonze X and Michenaud J P 1994 First-principles study of the stacking effect on the electronic properties of graphite(s) *Carbon* **32** 289–99

[18] Charlier J C, Michenaud J P and Ph Lambin 1992 Tight-binding density of electronic states of pregraphitic carbon *Phys. Rev.* B **46** 4540–3

[19] Shallcross S, Sharma S, Kandelaki E and Pankratov O A 2010 Electronic structure of turbostratic graphene *Phys. Rev.* B **81** 165105

[20] Bracamonte M V, Lacconi G I, Urreta S E and Foa Torres L E F 2014 On the nature of defects in liquid-phase exfoliated graphene *J. Phys. Chem.* C **118** 15455–9
[21] Stankovich S, Dikin D A, Piner R D, KohlhaasK A, Kleinhammes A and Jia Y *et al* 2007 Synthesis of graphene-based nanosheets via chemical reduction of exfoliated graphite oxide *Carbon* **45** 1558–65
[22] Song P, Zhang X, Sun M, Cui X and Lin Y 2012 Synthesis of graphene nanosheets via oxalic acid-induced chemical reduction of exfoliated graphite oxide *RSC Adv.* **2** 1168–73
[23] Guo H L, Wang X F, Qian Q Y, Wang F B and Xia X H 2009 A green approach to the synthesis of graphene nanosheets *ACS Nano.* **3** 2653–9
[24] Dou L T, Cui F, Yu Y, Khanarian G, Eaton S W and Yang Q *et al* 2016 Solution-processed copper/reduced-graphene-oxide core/shell nanowire transparent conductors *ACS Nano.* **10** 2600–6
[25] Tang L, Wang Y, Li Y, Feng H, Lu J and Li J 2009 Preparation, structure, and electrochemical properties of reduced graphene sheet films *Adv. Funct. Mater.* **19** 2782–59
[26] Anis A, Mohammad A A, Hussain A and Ahmed S E 2016 Reduced graphene oxide thin film on conductive substrates by bipolar electrochemistry *Sci. Rep.* **6** 21282
[27] Sundaram R S, Gomez-Navarro C, Balasubramanian K, Burghard M, Marko K K and Klaus K 2008 Electrochemical modification of graphene *Adv. Mater.* **20** 3050–3
[28] Reina A, Jia X, Ho J, Nezich D, Son H and Bulovic V *et al* 2009 Large area, few-layer graphene films on arbitrary substrates by chemical vapor deposition *Nano Lett.* **9** 30–5
[29] Liu L, Zhou H, Cheng R, Yu W J, Liu Y and Chen Y *et al* 2012 High-yield chemical vapor deposition growth of high-quality large-area AB-stacked bilayer graphene *ACS Nano.* **6** 8241–9
[30] Gomez T, Florez E, Rodriguez J A and Illas F 2011 Reactivity of transition metals (Pd, Pt, Cu, Ag, Au) toward molecular hydrogen dissociation: extended surfaces versus particles supported on TiC(001) or small is not always better and large is not always bad *J. Phys. Chem.* C **115** 11666–72
[31] Zhang X, Li H and Ding F 2014 Self-assembly of carbon atoms on transition metal surfaces —chemical vapor deposition growth mechanism of graphene *Adv. Mater.* **26** 5488–95
[32] Zhou Z, Habenicht B F and Guo Q 2013 Graphene Moiré structure grown on a pseudomorphic metal overlayer supported on Ru(0001) *Surf. Sci.* **611** 67–73
[33] Kim K S, Zhao Y, Jang H, Lee S Y, Kim J M and Kim K S *et al* 2009 Large-scale pattern growth of graphene films for stretchable transparent electrodes *Nature* **457** 706–10
[34] Li X, Cai W, An J, Kim S, Nah J and Yang D *et al* 2009 Large-area synthesis of high-quality and uniform graphene films on copper foils *Science* **324** 1312–4
[35] Zhou H, Yu W J, Liu L, Cheng R, Chen Y and Huang X *et al* 2013 Chemical vapour deposition growth of large single crystals of monolayer and bilayer graphene *Nat. Commun.* **4** 2096
[36] Su C Y, Lu A Y, Wu C Y, Li Y T, Liu K K and Zhang W *et al* 2011 Direct formation of wafer scale graphene thin layers on insulating substrates by chemical vapor deposition *Nano Lett.* **11** 3612–6
[37] Bae S, Kim H, Lee Y, Xu X, Park J S and Zheng Y *et al* 2010 Roll-to-roll production of 30-inch graphene films for transparent electrodes *Nat. Nanotechnol.* **5** 574–8
[38] Vijayaraghavan R K, Gaman C, Jose B, Mccoy A P, Cafolla T and McNally P J *et al* 2016 Pulsed-plasma physical vapor deposition approach toward the facile synthesis of multilayer

and monolayer graphene for anticoagulation applications *ACS Appl. Mater. Interfaces* **8** 4878–86

[39] Wu X Y, Zhong G F, D'Arsie L, Sugime H, Esconjauregui S and Robertson A W *et al* 2016 Growth of continuous monolayer graphene with millimeter-sized domains using industrially safe conditions *Sci. Rep.* **6** 21152

[40] Bosca A, Pedros J, Martinez J, Palacios T and Calle F 2016 Automatic graphene transfer system for improved material quality and efficiency *Sci. Rep.* **6** 21676

[41] Engel M, Steiner M, Lombardo A, Ferrari A C, v. Lohneysen H and Avouris P *et al* 2012 Light matter interaction in a micro-cavity controlled graphene transistor *Nat. Commun.* **3** 906–11

[42] Koppens F H L, Mueller T, Avouris Ph, Ferrari A C, Vitiello M S and Polini M 2014 Photodetectors based on graphene, other two-dimensional materials and hybrid systems *Nat. Nanotechnol.* **9** 780–93

[43] Bonaccorso F, Sun Z, Hasan T and Ferrari A C 2010 Graphene photonics and optoelectronics *Nat. Photonics* **4** 611–22

[44] Khan F, Baek S H and Kim J H 2016 One-step and controllable bipolar doping of reduced graphene oxide using TMAH as reducing agent and doping source for field effect transistors *Carbon* **100** 608–16

[45] Kumar A, Tyagi P, Dagar J and Srivastava R 2016 Tunable field effect properties in solid state and flexible graphene electronics on composite high-low k dielectric *Carbon* **99** 579–84

[46] Tseng S F, Haiso W T, Cheng P Y, Chung C K, Lin Y S and Chien S C *et al* 2016 Graphene-based chips fabricated by ultraviolet laser patterning for an electrochemical impedance spectroscopy *Sens. Actuators B Chem.* **226** 342–8

[47] Liu J B, Li P J, Chen Y F, Song X B, Mao Q and Wu Y *et al* 2016 Flexible terahertz modulator based on coplanar-gate graphene field-effect transistor structure *Optics Lett.* **41** 816–9

[48] Shown I, Hsu H C, Chang Y, Lin C H, Roy P K and Ganguly A *et al* 2014 Highly efficient visible light photocatalytic reduction of CO_2 to hydrocarbon fuels by Cu-nanoparticle decorated graphene oxide *Nano Lett.* **14** 6097–103

[49] Hsu H C, Shown I, Wei H Y, Chang Y C, Du H Y and Lin Y G *et al* 2013 Graphene oxide as a promising photocatalyst for CO_2 to methanol conversion *Nanoscale* **5** 262–8

[50] Idier J, Neri W, Labrugere C, Ly I, Poulin P and Backov R 2016 Modified silver nanowire transparent electrodes with exceptional stability against oxidation *Nanotechnology* **27** 105705

[51] Koppens F H L, Chang D E and de Abajo F J G 2011 Graphene plasmonics: a platform for strong light-matter interactions *Nano Lett.* **11** 3370–7

[52] Matyba P, Yamaguchi H, Eda G, Chhowalla M, Edman L and Robinson N D 2010 Graphene and mobile ions: the key to all-plastic, solution-processed light-emitting devices *ACS Nano* **4** 637–42

[53] Kusumawati Y, Koussi-Daoud S and Pauporte T 2016 TiO_2/graphene nanocomposite layers for improving the performances of dye-sensitized solar cells using a cobalt redox shuttle *J. Photochem. Photobiol.* **329** 54–60

[54] Xia F N, Mueller T, Lin Y M, Valdes-Garcia A and Avouris P 2009 Ultrafast graphene photodetector *Nat. Nanotechnol.* **4** 839–43

[55] Mueller T, Xia F and Avouris P 2010 Graphene photodetectors for high-speed optical communications *Nat. Photon.* **4** 297–301

[56] Liu M, Yin X B, Ulin-Avila E, Geng B S, Zentgraf T and Ju L *et al* 2011 A graphene-based broadband optical modulator *Nature* **474** 64–7
[57] Xu P, Yang Y, Qi D, Barber S D, Schoelz J K and Ackerman M L *et al* 2012 Electronic transition from graphite to graphene via controlled movement of the top layer with scanning tunneling microscopy *Phys. Rev.* B **86** 085428
[58] Rong Z Y 1994 Extended modifications of electronic structures caused by defects: scanning tunneling microscopy of graphite *Phys. Rev.* B **50** 1839–43
[59] Pong W T, Bendall J and Durkan C 2007 Observation and investigation of graphite superlattice boundaries by scanning tunneling microscopy *Surf. Sci.* **601** 498
[60] Campanera J M, Savini G, Suarez-Martinez I and Heggie M I 2007 Density functional calculations on the intricacies of moiré patterns on graphite *Phys. Rev.* B **75** 235449
[61] Kazemi A S, Crampin S and Ilie A 2013 Stacking-dependent superstructures at stepped armchair interfaces of bilayer/trilayer graphene *Appl. Phys. Lett.* **102** 163111
[62] Biedermann L B, Bolen M L, Capano M A, Zemlyanov D and Reifenberger R G 2009 Insights into few-layer epitaxial graphene growth on 4H-SiC(000) substrates from STM studies *Phys. Rev.* B **79** 125411
[63] Que Y, Xiao W, Chen H, Wang D, Du S and Gao H J 2015 Stacking-dependent electronic property of trilayer graphene epitaxially grown on Ru(0001) *Appl. Phys. Lett.* **107** 263101
[64] Do T N, Lin C Y, Lin Y P, Shih P H and Lin M F 2015 Configuration-enriched magneto-electronic spectra of AAB-stacked trilayer graphene *Carbon* **94** 619–32
[65] Do T N, Shih P H, Chang C P, Lin C Y and Lin M F 2015 Rich magneto-absorption spectra in AAB-stacked trilayer graphene *Phys. Chem. Chem. Phys.* **18** 17597–605
[66] Huang Y K, Chen S C, Ho Y H, Lin C Y and Lin M F 2014 Feature-rich magnetic quantization in sliding bilayer graphenes *Sci. Rep.* **4** 7509
[67] Kindermann M and Mele E J 2011 Landau quantization in twisted bilayer graphene: the Dirac comb *Phys. Rev.* B **84** 161406
[68] Ohta T, Bostwick A and McChesney J L 2007 Interlayer interaction and electronic screening in multilayer graphene investigated with angle-resolved photoemission spectroscopy *Phys. Rev. Lett.* **98** 206802
[69] Moreau E, Godey S, Wallart X, Razado-Colambo I, Avila J and Asensio M C *et al* 2013 High-resolution angle-resolved photoemission spectroscopy study of monolayer and bilayer graphene on the C-face of SiC *Phys. Rev.* B **88** 075406
[70] Coletti C, Forti S, Principi A, Emtsev K V, Zakharov A A and Daniels K M *et al* 2013 Revealing the electronic band structure of trilayer graphene on SiC: an angle-resolved photoemission study *Phys. Rev.* B **88** 155439
[71] Pletikosić I, Kralj M, Pervan P, Brako R, Coraux J and N'Diaye A T *et al* 2009 Dirac cones and minigaps for graphene on Ir(111) *Phys. Rev. Lett.* **102** 056808
[72] Bostwick A, Ohta T, Seyller T, Horn K and Rotenberg E 2007 Quasiparticle dynamics in graphene *Nat. Phys.* **3** 36–40
[73] Emtsev K V, Speck F, Seyller T, Ley L and Riley J D 2008 Interaction, growth, and ordering of epitaxial graphene on SiC0001 surfaces: a comparative photoelectron spectroscopy study *Phys. Rev.* B **77** 155303
[74] Sprinkle M, Siegel D, Hu Y, Hicks J, Tejeda A and Taleb-Ibrahimi A *et al* 2009 First direct observation of a nearly ideal graphene band structure *Phys. Rev. Lett.* **103** 226803

[75] Zhang X, Han W P, Qiao X F, Tan Q H, Wang Y F and Zhang J *et al* 2016 Raman characterization of AB- and ABC-stacked few-layer graphene by interlayer shear modes *Carbon* **99** 118–22
[76] Raghavan S, Denig T J, Nelson T C, Chaudhari S and Stinespring C D 2016 Characterization of graphene-on-insulator films formed using plasma based surface chemistry *Carbon* **99** 212–21
[77] Wallace P R 1947 The band theory of graphite *Phys. Rev.* **71** 622–34
[78] Tsai S J, Chiu Y H, Ho Y H and Lin M F 2012 Gate-voltage-dependent Landau levels in AA-stacked bilayer graphene *Chem. Phys. Lett.* **550** 104–10
[79] Wang D and Jin G 2013 Tunneling magnetoresistance tuned by a vertical electric field in an AA-stacked graphene bilayer with double magnetic barriers *J. Appl. Phys.* **114** 233701
[80] Lobato I and Partoens B 2011 Multiple Dirac particles in AA-stacked graphite and multilayers of graphene *Phys. Rev.* B **83** 165429
[81] Lu C L, Chang C P, Huang Y C, Lu J M, Hwang C C and Lin M F 2006 Low-energy electronic properties of the AB-stacked few-layer graphites *J. Phys.: Condens. Matter* **18** 5849–59
[82] Gruneis A, Attaccalite C, Wirtz L, Shiozawa H, Saito R and Pichler T *et al* 2008 Tight-binding description of the quasiparticle dispersion of graphite and few-layer graphene *Phys. Rev.* B **78** 205425
[83] McCann E and Koshino M 2013 The electronic properties of bilayer graphene *Rep. Prog. Phys.* **76** 056503
[84] Partoens B and Peeters F M 2007 Normal and Dirac fermions in graphene multilayers: tight-binding description of the electronic structure *Phys. Rev.* B **75** 193402
[85] Luican A, Li G H, Reina A, Kong J, Nair R R and Novoselov K S *et al* 2011 Single-layer behavior and its breakdown in twisted graphene layers *Phys. Rev. Lett.* **106** 126802
[86] Kim K S, Walter A L, Moreschini L, Seyller T, Horn K and Rotenberg E *et al* 2013 Coexisting massive and massless Dirac fermions in symmetry-broken bilayer graphene *Nat. Mater.* **12** 887–92
[87] Li G H, Luican A, Lopes dos Santos J M B, Castro Neto A H, Reina A and Kong J *et al* 2010 Observation of van Hove singularities in twisted graphene layers *Nat. Phys.* **6** 109–13
[88] Goto H, Uesugi E, Eguchi R and Kubozono Y 2013 Parity effects in few-layer graphene *Nano Lett.* **3** 5153–8
[89] Latil S, Meunier V and Henrard L 2007 Massless fermions in multilayer graphitic systems with misoriented layers: *ab initio* calculations and experimental fingerprints *Phys. Rev.* B **76** 201402 (R)
[90] Koshino M and McCann E 2010 Parity and valley degeneracy in multilayer graphene *Phys. Rev.* B **81** 115315
[91] Maka K F, Sfeirb M Y, Misewichb J A and Heinza T F 2010 The evolution of electronic structure in few-layer graphene revealed by optical spectroscopy *Proc. Natl Acad. Sci. USA.* **107** 14999–15004
[92] Yan X Z and Ting C S 2015 Current orderings of interacting electrons in bilayer graphene *Phys. Rev.* B **92** 075442
[93] Castro Neto A H, Guinea F, Peres N M R, Novoselov K S and Geim A K 2009 The electronic properties of graphene *Rev. Mod. Phys.* **81** 109–162
[94] Latil S and Henrard L 2006 Charge carriers in few-layer graphene films *Phys. Rev. Lett.* **97** 036803

[95] Zhang F, Sahu B, Min H and MacDonald A H 2010 Band structure of ABC-stacked graphene trilayers *Phys. Rev.* B **82** 035409
[96] Xiao R, Tasnadi F, Koepernik K, Venderbos J W F, Richter M and Taut M 2011 Density functional investigation of rhombohedral stacks of graphene: topological surface states, nonlinear dielectric response, and bulk limit *Phys. Rev.* B **84** 165404
[97] Guinea F, Castro Neto A H and Peres N M R 2006 Electronic states and Landau levels in graphene stacks *Phys. Rev.* B **73** 245426
[98] Wang H, Gao J H and Zhang F C 2013 Flat band electrons and interactions in rhombohedral trilayer graphene *Phys. Rev.* B **87** 155116
[99] Kopnin N B, Heikkila T T and Volovik G E 2011 High-temperature surface superconductivity in topological flat-band systems *Phys. Rev.* B **83** 220503
[100] Lu C L, Chang C P, Huang Y C, Chen R B and Lin M L 2006 Influence of an electric field on the optical properties of few-layer graphene with AB stacking *Phys. Rev.* B **73** 144427
[101] Lu C L, Chang C P, Huang Y C, Ho J H, Hwang C C and Lin M F 2007 Electronic properties of AA- and ABC-stacked few-layer graphites *J. Phys. Soc. Jap.* **76** 024701
[102] McCann E 2006 Asymmetry gap in the electronic band structure of bilayer graphene *Phys. Rev.* B **74** 161403
[103] Min H, Sahu B, Banerjee S K and MacDonald A H 2007 *Ab initio* theory of gate induced gaps in graphene bilayers *Phys. Rev.* B **75** 155115
[104] Kumar S B and Guo J 2011 Multilayer graphene under vertical electric field *App. Phy. Lett.* **98** 222101
[105] Wu B R 2011 Field modulation of the electronic structure of trilayer graphene *App. Phy. Lett.* **98** 263107
[106] Avetisyan A A, Partoens B and Peeters F M 2009 Electric field tuning of the band gap in graphene multilayers *Phys. Rev.* B **79** 035421
[107] Castro E V, Novoselov K S, Morozov S V, Peres N M R, Lopes dos Santos J M B and Nilsson J *et al* 2007 Biased bilayer graphene: semiconductor with a gap tunable by the electric field effect *Phys. Rev. Lett.* **99** 216802
[108] Yankowitz M, Wang F L, Lau C N and LeRoy B J 2013 Local spectroscopy of the electrically tunable band gap in trilayer graphene *Phys. Rev.* B **87** 165102
[109] Zhang Y, Tang T T, Girit C, Hao Z, Martin M C and Zettl A *et al* 2009 Direct observation of a widely tunable bandgap in bilayer graphene *Nature* **459** 820–3
[110] Lui C H, Li Z, Mak K F, Cappelluti E and Heinz T F 2011 Observation of an electrically tunable band gap in trilayer graphene *Nat. Phys.* **7** 944–7
[111] Taisuke O, Aaron B and Thomas S 2006 Controlling the electronic structure of bilayer graphene *Science* **313** 951–4
[112] Bao W, Jing L, Velasco J, Lee Y, Liu G and Tran D *et al* 2011 Stacking-dependent band gap and quantum transport in trilayer graphene *Nat. Phys.* **7** 948–52
[113] Wang F, Zhang Y, Tian C, Girit C, Zettl A and Crommie M *et al* 2008 Gate-variable optical transitions in graphene *Science* **320** 206–9
[114] Craciun M F, Russo S, Yamamoto M, Oostinga J B, Morpurgo A F and Tarucha S 2009 Trilayer graphene is a semimetal with a gate-tunable band overlap *Nat. Nanotechnol.* **4** 383–8
[115] Zhang W, Lin C T, Liu K K, Tite T, Su C Y and Chang C H *et al* 2011 Opening electrical band gap of bilayer graphene with molecular doping *ACS Nano.* **5** 7517–24

[116] Lee C, Kim J, Kim S, Chang Y J, Kim K S and Hong B *et al* 2016 Strong hole-doping and robust resistance-decrease in proton-irradiated graphene *Sci. Rep.* **6** 21311
[117] Liu H, Liu Y and Zhu D 2011 Chemical doping of graphene *J. Mater. Chem.* **21** 3335–45
[118] Wei D, Liu Y, Wang Y, Zhang H, Huang L and Yu G 2009 Synthesis of N-doped graphene by chemical vapor deposition and its electrical properties *Nano Lett.* **9** 1752–8
[119] Nakada K and Ishii A 2011 Migration of adatom adsorption on graphene using DFT calculation *Solid State Commun.* **151** 13–6
[120] Rana M, Arora G and Gautam U K 2015 N- and S-doped high surface area carbon derived from soya chunks as scalable and efficient electrocatalysts for oxygen reduction *Sci. Technol. Adv. Mat.* **16** 014803
[121] Lin Y P, Ksari Y, Aubel D, Hajjar-Garreau S, Borvon G and Spiegel Y *et al* 2016 Efficient and low-damage nitrogen doping of graphene via plasma-based methods *Carbon* **100** 337–44
[122] Arjmand M, Chizari K, Krause B, Potschke P and Sundararaj U 2016 Effect of synthesis catalyst on structure of nitrogen-doped carbon nanotubes and electrical conductivity and electromagnetic interference shielding of their polymeric nanocomposites *Carbon* **98** 358–72
[123] Raquet B, Avriller R, Lassagne B, Nanot S, Escoffier W and Broto J M *et al* 2008 Onset of Landau-level formation in carbon-nanotube-based electronic Fabry-Pérot resonators *Phys. Rev. Lett.* **101** 046803
[124] Chang C P, Lu C L, Shyu F L, Chen R B, Fang Y K and Lin M F 2004 Magnetoelectronic properties of a graphite sheet *Carbon* **42** 2975–80
[125] Ho J H, Lai Y H, Chiu Y H and Lin M F 2008 Landau levels in graphene *Physica* E **40** 1722–5
[126] Lin C Y, Wu J Y, Ou Y J, Chiu Y H and Lin M F 2015 Magneto-electronic properties of multilayer graphenes *Phys. Chem. Chem. Phys.* **17** 26008–35
[127] Chang C P 2011 Exact solution of the spectrum and magneto-optics of multilayer hexagonal graphene *J. Appl. Phys.* **110** 013725
[128] Lai Y H, Ho J H, Chang C P and Lin M F 2008 Magnetoelectronic properties of bilayer bernal graphene *Phys. Rev.* B **77** 085426
[129] McCann E and Fal'ko V I 2006 Landau-level degeneracy and quantum Hall effect in a graphite bilayer *Phys. Rev. Lett.* **96** 086805
[130] Min H and MacDonald A H 2008 Chiral decomposition in the electronic structure of graphene multilayers *Phys. Rev.* B **77** 155416
[131] Koshino M and McCann E 2011 Landau level spectra and the quantum Hall effect of multilayer graphene *Phys. Rev.* B **83** 165443
[132] Min H and MacDonald A H 2008 Electronic structure of multilayer graphene *Prog. Theor. Phys. Supplement* **176** 227–52
[133] Aoki M and Amawash H 2007 Dependence of band structures on stacking and field in layered graphene *Solid State Commun.* **142** 123–7
[134] Avetisyan A A, Partoens B and Peeters F M 2010 Stacking order dependent electric field tuning of the band gap in graphene multilayers *Phys. Rev.* B **81** 115432
[135] Koshino M and McCann E 2009 Gate-induced interlayer asymmetry in ABA-stacked trilayer graphene *Phys. Rev.* B **79** 125443
[136] Kim D S, Kwon H, Nikitin A Y, Ahn S, Martin-Moreno L and Garcia-Vidal F J *et al* 2015 Stacking structures of few-layer graphene revealed by phase-sensitive infrared nanoscopy *ACS Nano* **9** 6765–73

[137] Cadden-Zimansky P, Jiang Z, Li Z Q, Tung L C, Schwartz M E and Takita M *et al* 2010 Interaction-induced shift of the cyclotron resonance of graphene using infrared spectroscopy *Phys. Rev. Lett.* **104** 067404
[138] Faugeras C, Amado M, Kossacki P, Orlita M, Kuhne M and Nicolet A A L *et al* 2011 Magneto-Raman scattering of graphene on graphite: electronic and phonon excitations *Phys. Rev. Lett.* **107** 036807
[139] Zhao H M, Lin Y C, Yeh C H, Tian H, Chen Y C and Xie D *et al* 2014 Growth and raman spectra of single-crystal trilayer graphene with different stacking orientations *ACS Nano.* **8** 10766–73
[140] Cong C X, Jung J, Cao B C, Qiu C Y, Shen X N and Ferreira A *et al* 2015 Magnetic oscillation of optical phonon in ABA- and ABC-stacked trilayer graphene *Phys. Rev.* B **91** 235403
[141] Sena S H R, Pereira J M, Peeters F M and Farias G A 2011 Landau levels in asymmetric graphene trilayers *Phys. Rev.* B **84** 205448
[142] Yuan S, Roldan R and Katsnelson M I 2011 Landau level spectrum of ABA- and ABC-stacked trilayer graphene *Phys. Rev.* B **84** 125455
[143] Ho C H, Tsai S J, Chen R B, Chiu Y H and Lin M F 2011 Low-energy Landau level spectrum in ABC-stacked trilayer graphene *J. Nanosci. Nanotechnol.* **11** 4938–47
[144] Ho C H, Ho Y H, Chiu Y H, Chen Y N and Lin M F 2011 Magneto-electronic properties of rhombohedral trilayer graphene: Peierls tight-binding model *Ann. Phys.* **326** 721–39
[145] Koshino M and McCann E 2009 Trigonal warping and Berry's phase $N\pi$ in ABC-stacked multilayer graphene *Phy. Rev.* B **80** 165409
[146] Lin C Y, Wu J Y, Chiu Y H, Chang C P and Lin M F 2014 Stacking-dependent magnetoelectronic properties in multilayer graphene *Phys. Rev.* B **90** 205434
[147] Lin Y P, Wang J, Lu J M, Lin C Y and Lin M F 2014 Energy spectra of ABC-stacked trilayer graphene in magnetic and electric fields *RSC Adv.* **4** 56552–60
[148] Tran N T T, Lin S Y, Glukhova O E and Lin M F 2015 Configuration-induced rich electronic properties of bilayer graphene *J Phys. Chem.* C **119** 10623–30
[149] Inoue M 1962 Landau levels and cyclotron resonance in graphite *J. Phys. Soc. Jpn* **17** 808
[150] Ou Y C, Sheu J K, Chiu Y H, Chen R B and Lin M F 2011 Influence of modulated fields on the Landau level properties of graphene *Phys. Rev.* B **83** 195405
[151] Chiu Y H, Ou Y C, Liao Y Y and Lin M F 2010 Optical-absorption spectra of single-layer graphene in a periodic magnetic field *J. Vac. Sci. Technol.* B **28** 386–90
[152] Ou Y C, Chiu Y H, Yang P H and Lin M F 2014 The selection rule of graphene in a composite magnetic field *Opti. Express* **22** 7473–91
[153] Chiu C W, Chen S C, Huang Y C, Shyu F L and Lin M F 2013 Critical optical properties of AA-stacked multilayer graphenes *Appl. Phys. Lett.* **103** 041907
[154] Lee S H, Ho Y H, Chiu C W and Lin M F 2010 Optical properties of deformed few-layer graphenes with AB stacking *J. Appl. Phys.* **108** 043509
[155] Kadi F and Malic E 2014 Optical properties of bernal-stacked bilayer graphene: a theoretical study *Phys. Rev.* B **89** 045419
[156] Koshino M 2013 Stacking-dependent optical absorption in multilayer graphene *New J. Phys.* **15** 015010
[157] Chiu C W, Ho Y H, Shyu F L and Lin M F 2014 Layer-enriched optical spectra of AB-stacked multilayer graphene *App. Phys. Express* **7** 115102

[158] Ho Y H, Chiu Y H, Lin D H, Chang C P and Lin M F 2010 Magneto-optical selection rules in bilayer Bernal graphene *ACS Nano* **4** 1465–72
[159] Abergel D S L and Fal'ko V I 2007 Optical and magneto-optical far-infrared properties of bilayer graphene *Phys. Rev.* B **75** 155430
[160] Chiu C W, Huang Y C, Shyu F L and Lin M F 2012 Optical absorption spectra in ABC-stacked graphene superlattice *Synthetic Met.* **162** 800–4
[161] Yan J A, Ruan W Y and Chou M Y 2011 Enhanced optical conductivity induced by surface states in ABC-stacked few-layer graphene *Phys. Rev.* B **83** 245418
[162] Lin C Y, Wu J Y, Chang C P and Lin M F 2014 Magneto-optical selection rules of curved graphene nanoribbons and carbon nanotubes *Carbon* **69** 151–61
[163] Gusynin V P and Sharapov S G 2006 Transport of Dirac quasiparticles in graphene: Hall and optical conductivities *Phys. Rev.* B **73** 245411
[164] Gusynin V P, Sharapov S G and Carbotte J P 2007 Anomalous absorption line in the magneto-optical response of graphene *Phys. Rev. Lett.* **98** 157402
[165] Koshino M and Ando T 2008 Magneto-optical properties of multilayer graphene *Phy. Rev.* B **77** 115313
[166] Li Z Q, Henriksen E A, Jiang Z, Hao Z, Martin M C and Kim P *et al* 2008 Dirac charge dynamics in graphene by infrared spectroscopy *Nat. Phys.* **4** 532–5
[167] Zhang L M, Li Z Q, Basov D N, Fogler M M, Hao Z and Martin M C 2008 Determination of the electronic structure of bilayer graphene from infrared spectroscopy *Phys. Rev.* B **78** 235408
[168] Kuzmenko A B, van Heumen E, van der Marel D, Lerch P, Blake P and Novoselov K S *et al* 2009 Infrared spectroscopy of electronic bands in bilayer graphene *Phys. Rev.* B **79** 115441
[169] Faugeras C, Berciaud S, Leszczynski P, Henni Y, Nogajewski K and Orlita M *et al* 2015 Landau level spectroscopy of electron–electron interactions in graphene *Phys. Rev. Lett.* **114** 126804
[170] Orlita M, Faugeras C, Barra A L, Martinez G, Potemski M and Basko D M *et al* 2015 Infrared magneto-spectroscopy of two-dimensional and three-dimensional massless fermions: a comparison *J. Appl. Phys.* **117** 112803
[171] Berciaud S, Potemski M and Faugeras C 2014 Probing electronic excitations in mono- to pentalayer graphene by micro magneto-Raman spectroscopy *Nano Lett.* **14** 4548–53
[172] Faugeras C, Binder J, Nicolet A A L, Leszczynski P, Kossacki P and Wysmolek A *et al* 2014 A micro-magneto-Raman scattering study of graphene on a bulk graphite substrate *EPL* **108** 27011
[173] Li Z Q, Henriksen E A, Jiang Z, Hao Z, Martin M C and Kim P *et al* 2009 Band structure asymmetry of bilayer graphene revealed by infrared spectroscopy *Phys. Rev. Lett.* **102** 037403
[174] Mak K F, Shan J and Heinz T F 2010 Electronic structure of few-layer graphene: experimental demonstration of strong dependence on stacking sequence *Phys. Rev. Lett.* **104** 176404
[175] Lin Y P, Lin C Y, Ho Y H, Do T N and Lin M F 2015 Magneto-optical properties of ABC-stacked trilayer graphene *Phys. Chem. Chem. Phys.* **17** 15921–7
[176] Lin Y P, Lin C Y, Chang C P and Lin M F 2015 Electric-field-induced rich magneto-absorption spectra of ABC-stacked trilayer graphene *RSC Adv.* **5** 80410

[177] Jiang Z, Henriksen E A, Tung L C, Wang Y J, Schwartz M E and Han M Y *et al* 2007 Infrared spectroscopy of Landau levels of graphene *Phys. Rev. Lett.* **98** 197403
[178] Kuhne P, Darakchieva V, Yakimova R, Tedesco J D, Myers-Ward R L and Eddy C R *et al* 2013 Polarization selection rules for inter-Landau-level transitions in epitaxial graphene revealed by the infrared optical Hall effect *Phys. Rev. Lett.* **111** 077402
[179] Orlita M, Faugeras C, Plochocka P, Neugebauer P, Martinez G and Maude D K *et al* 2008 Approaching the Dirac point in high-mobility multilayer epitaxial graphene *Phys. Rev. Lett.* **101** 267601
[180] Plochocka P, Faugeras C, Orlita M, Sadowski M L, Martinez G and Potemski M *et al* 2008 High-energy limit of massless Dirac fermions in multilayer graphene using magneto-optical transmission spectroscopy *Phys. Rev. Lett.* **100** 087401
[181] Daboussi A, Mandhour L, Fuchs J N and Jaziri S 2014 Tunable zero-energy transmission resonances in shifted graphene bilayer *Phys. Rev.* B **89** 085426
[182] Pedersen J G and Pedersen T G 2011 Tight-binding study of the magneto-optical properties of gapped graphene *Phys. Rev.* B **84** 115424
[183] Ho Y H, Wu J Y, Chen R B and Lin M F 2010 Optical transitions between Landau levels: AA-stacked bilayer graphene *App. Phys. Lett.* **97** 101905
[184] Orlita M, Faugeras C, Borysiuk J, Baranowski J M, Strupiński W and Sprinkle M *et al* 2011 Magneto-optics of bilayer inclusions in multilayered epitaxial graphene on the carbon face of SiC *Phys. Rev.* B **83** 125302
[185] Orlita M, Faugeras C, Schneider J M, Martinez G, Maude D K and Potemski M 2009 Graphite from the viewpoint of Landau level spectroscopy: an effective graphene bilayer and monolayer *Phys. Rev. Lett.* **102** 166401
[186] Henriksen E A, Jiang Z, Tung L C, Schwartz M E, Takita M and Wang Y J *et al* 2008 Cyclotron resonance in bilayer graphene *Phys. Rev. Lett.* **100** 087403
[187] Ellis C T, Stier A V, Kim M H, Tischler J G, Glaser E R and Myers-Ward R L *et al* 2013 Magneto-optical fingerprints of distinct graphene multilayers using the giant infrared Kerr effect *Sci. Rep.* **3** 3143
[188] Tung L C, Cadden-Zimansky P, Qi J, Jiang Z and Smirnov D 2011 Measurement of graphite tight-binding parameters using high-field magnetoreflectance *Phys. Rev.* B **84** 153405
[189] Plochocka P, Solane P Y, Nicholas R J, Schneider J M, Piot B A and Maude D K *et al* 2012 Origin of electron-hole asymmetry in graphite and graphene *Phys. Rev.* B **85** 245410
[190] Ho J H, Lu C L, Hwang C C, Chang C P and Lin M F 2006 Coulomb excitations in AA- and AB-stacked bilayer graphites *Phys. Rev.* B **74** 085406
[191] Ho J H, Chang C P and Lin M F 2005 Electronic excitations of the multilayered graphite *Phys. Lett.* A **352** 446–50
[192] Lin M F, Chuang Y C and Wu J Y 2012 Electrically tunable plasma excitations in AA-stacked multilayer graphene *Phys. Rev.* B **86** 125434
[193] Wu J Y, Chen S C, Roslyak O, Gumbs G and Lin M F 2011 Plasma excitations in graphene: their spectral intensity and temperature dependence in magnetic field *ACS Nano* **5** 1026–32
[194] Lozovik Y E and Sokolik A A 2012 Influence of Landau level mixing on the properties of elementary excitations in graphene in strong magnetic field *Nano Res. Lett.* **7** 134
[195] Wu J Y, Gumbs G and Lin M F 2014 Combined effect of stacking and magnetic field on plasmon excitations in bilayer graphene *Phys. Rev.* B **89** 165407

[196] Wu J Y, Lin C Y, Gumbs G and Lin M F 2015 The effect of perpendicular electric field on temperature-induced plasmon excitations for intrinsic silicene *RSC Adv.* **5** 51912–8
[197] Yuan S, Roldan R and Katsnelson M I 2011 Excitation spectrum and high-energy plasmons in single-layer and multilayer graphene *Phys. Rev.* B **84** 035439
[198] Wang W, Kinaret J M and Apell S P 2012 Excitation of edge magnetoplasmons in semi-infinite graphene sheets: temperature effects *Phys. Rev.* B **85** 235444
[199] Roldan R, Fuchs J N and Goerbig M O 2009 Collective modes of doped graphene and a standard two-dimensional electron gas in a strong magnetic field: linear magnetoplasmons versus magnetoexcitons *Phys. Rev.* B **80** 085408
[200] Roldan R and Brey L 2013 Dielectric screening and plasmons in AA-stacked bilayer graphene *Phy. Rev.* B **88** 115420
[201] Gumbs G and Huang D 2007 Electronically modulated two-dimensional plasmons coupled to surface plasmon modes *Phys. Rev.* B **75** 115314
[202] Roslyak O, Gumbs G and Huang D 2011 Plasma excitations of dressed Dirac electrons in graphene layers *J. Appl. Phys.* **109** 113721
[203] Geim A K and Novoselov K S 2007 The rise of graphene *Nat. Mater.* **6** 183–91
[204] Novoselov K S, Geim A K, Morozov S V, Jiang D, Katsnelson M I and Grigorieva I V *et al* 2005 Two-dimensional gas of massless Dirac fermions in graphene *Nature* **438** 197–200
[205] Hao Y, Bharathi M S, Wang L, Liu Y, Chen H and Nie S *et al* 2013 The role of surface oxygen in the growth of large single-crystal graphene on copper *Science* **342** 720–3
[206] Chen J H, Jang C, Xiao S, Ishigami M and Fuhrer M S 2008 Intrinsic and extrinsic performance limits of graphene devices on SiO_2 *Nat. Nanotechnol.* **3** 206–9
[207] Morozov S V, Novoselov K S, Katsnelson M I, Schedin F, Elias D C and Jaszczak J A *et al* 2008 Giant intrinsic carrier mobilities in graphene and its bilayer *Phys. Rev. Lett.* **100** 016602
[208] Pallecchi E, Lafont F, Cavaliere V, Schopfer F, Mailly D and Poirier W *et al* 2014 High electron mobility in epitaxial graphene on 4H-SiC(0001) via post-growth annealing under hydrogen *Sci. Rep.* **4** 4558
[209] Schwierz F 2010 Graphene transistors *Nat. Nanotechnol.* **5** 487–96
[210] Gusynin V P and Sharapov S G 2005 Unconventional integer quantum Hall effect *Phys. Rev. Lett.* **95** 146801
[211] Zhang Y B, Tan Y W, Stormer H L and Kim P 2005 Experimental observation of the quantum Hall effect and Berry's phase in graphene *Nature* **438** 201–4
[212] Novoselov K S, Jiang Z, Zhang Y, Morozov S V, Stormer H L and Zeitler U *et al* 2007 Room-temperature quantum Hall effect in graphene *Science* **315** 1379–9
[213] Hsu Y F and Guo G Y 2010 Anomalous integer quantum Hall effect in AA-stacked bilayer graphene *Phys. Rev.* B **82** 165404
[214] Novoselov K S, McCann E, Morozov S V, Fal'ko V I, Katsnelson M I and Zeitler U *et al* 2006 Unconventional quantum Hall effect and Berry's phase of 2π in bilayer graphene *Nat. Phys.* **2** 177–80
[215] Oostinga J B, Heersche H B, Liu X, Morpurgo A F and Vandersypen L M K 2008 Gate-induced insulating state in bilayer graphene devices *Nat. Mater.* **7** 151–7
[216] Taychatanapat T, Watanabe K, Taniguchi T and Jarillo-Herrero P 2008 Quantum Hall effect and Landau-level crossing of Dirac fermions in trilayer graphene *Nat. Phys.* **7** 621–5

[217] van Elferen H J, Veligura A, Tombros N, Kurganova E V, van Wees B J and Maan J C *et al* 2013 Fine structure of the lowest Landau level in suspended trilayer graphene *Phys. Rev.* B **88** 121302
[218] Kumar A, Escoffier W, Poumirol J M, Faugeras C, Arovas D P and Fogler M M *et al* 2011 Integer quantum Hall effect in trilayer graphene *Phys. Rev. Lett.* **107** 126806
[219] Zhang L, Zhang Y, Camacho J, Khodas M and Zaliznyak I 2011 The experimental observation of quantum Hall effect of $l = 3$ chiral quasiparticles in trilayer graphene *Nat. Phys.* **7** 953–7
[220] Lee Y, Velasco J, Tran D, Zhang F, Bao W and Jing L *et al* 2013 Broken symmetry quantum Hall states in dual-gated ABA trilayer graphene *Nano Lett.* **13** 1627–31
[221] Henriksen E A, Nandi D and Eisenstein J P 2012 Quantum Hall effect and semimetallic behavior of dual-gated ABA-stacked trilayer graphene *Phys. Rev.* X **2** 011004
[222] Foa Torres L E F, Perez-Piskunow P M, Balseiro C A and Usaj G 2014 Multiterminal conductance of a Floquet topological insulator *Phys. Rev. Lett.* **113** 266801
[223] Ezawa M 2012 A topological insulator and helical zero mode in silicene under an inhomogeneous electric field *New J. Phys.* **14** 033003
[224] Ezawa M 2012 Valley-polarized metals and quantum anomalous Hall effect in silicene *Phys. Rev. Lett.* **109** 055502
[225] Tai Y Y, Choi H C, Ahmed T, Ting C S and Zhu J X 2015 Edge states and local electronic structure around an adsorbed impurity in a topological superconductor *Phys. Rev.* B **92** 174514
[226] Li M Y, Shi Y, Cheng C C, Lu L S, Lin Y C and Tang H L *et al* 2015 Epitaxial growth of a monolayer WSe_2-MoS_2 lateral p-n junction with an atomically sharp interface science **349** 524–58
[227] Ho Y H, Wang Y H and Chen H Y 2014 Magnetoelectronic and optical properties of a MoS_2 monolayer *Phys. Rev.* B **89** 155316
[228] Ho Y H, Chiu C W and Lin M F 2014 Magneto-optical spectra of transition metal dichalcogenides: a comparative study *Appl. Phys. Lett.* **105** 222411
[229] Tabert C J and Nicol E J 2013 Valley-spin polarization in the magneto-optical response of silicene and other similar 2D crystals *Phys. Rev. Lett.* **110** 197402
[230] Tabert C J and Nicol E J 2013 Magneto-optical conductivity of silicene and other buckled honeycomb lattices *Phys. Rev.* B **88** 085434
[231] Schafgans A A, Post K W, Taskin A A, Ando Y, Qi X L and Chapler B C *et al* 2012 Landau level spectroscopy of surface states in the topological insulator $Bi_{0.91}Sb_{0.09}$ via magneto-optics *Phys. Rev.* B **85** 195440
[232] LaForge A D, Frenzel A, Pursley B C, Lin T, Liu X F and Shi J *et al* 2010 Optical characterization of Bi_2Se_3 in a magnetic field: infrared evidence for magnetoelectric coupling in a topological insulator material *Phys. Rev.* B **81** 125120
[233] Morkoc H, Strite S, Gao G B, Lin M E, Sverdlov B and Burns M 1994 Large-band-gap SiC, III–V nitride, and II–VI ZnSe-based semiconductor-device technologies *J. Appl. Phys.* **76** 1363–98
[234] Ando T, Fowler A B and Stern F 1982 Electronic properties of two-dimensional systems *Rev. Mod. Phys.* **54** 437–72
[235] Hendry E, Hale P J, Moger J, Savchenko A K and Mikhailov S A 2010 Coherent nonlinear optical response of graphene *Phys. Rev. Lett.* **105** 097401

[236] Ferrari A C, Meyer J C, Scardaci V, Casiraghi C, Lazzeri M and Mauri F *et al* 2006 Raman spectrum of graphene and graphene layers *Phys. Rev. Lett.* **97** 187401
[237] Nyakiti L O, Myers-Ward R L, Wheeler V D, Imhoff E A, Bezares F J and Chun H *et al* 2012 Bilayer graphene grown on 4H-SiC (0001) step-free mesas *Nano Lett.* **12** 1749–56
[238] Lui C H, Li Z, Chen Z, Klimov P V, Brus L E and Heinz T F 2011 Imaging stacking order in few-layer graphene *Nano Lett.* **11** 164–9
[239] Cancado L G, Takai K, Enoki T, Endo M, Kim Y A and Mizusaki H *et al* 2008 Measuring the degree of stacking order in graphite by raman spectroscopy *Carbon* **46** 272–5
[240] Fang W, Hsu A L, Caudillo R, Song Y, Birdwell A G and Zakar E *et al* 2013 Rapid identification of stacking orientation in isotopically labeled chemical-vapor grown bilayer graphene by raman spectroscopy *Nano Lett.* **13** 1541–8
[241] Poncharal P, Ayari A, Michel T and Sauvajol J L 2008 Raman spectra of misoriented bilayer graphene *Phys. Rev.* B **78** 113407
[242] Malard L M, Nilsson J, Elias D C, Brant J C, Plentz F and Alves E S *et al* 2007 Probing the electronic structure of bilayer graphene by Raman scattering *Phys. Rev.* B **76** 201401
[243] Xie L M, Wang H L, Jin C H, Wang X R, Jiao L Y and Suenaga K *et al* 2011 Graphene nanoribbons from unzipped carbon nanotubes: atomic structures, Raman spectroscopy, and electrical properties *J. Am. Chem. Soc.* **133** 10394–7
[244] Matsui T, Kambara H, Niimi Y, Tagami K, Tsukada M and Fukuyama H 2005 STS observations of Landau levels at graphite surfaces *Phys. Rev.* B **94** 226403
[245] Uchoa B, Yang L, Tsai S W, Peres N M and Castro Neto A H 2009 Theory of scanning tunneling spectroscopy of magnetic adatoms in graphene *Phys. Rev. Lett.* **103** 206804
[246] Miller D L, Kubista K D, Rutter G M, Ruan M, de Heer W A and First P N *et al* 2009 Observing the quantization of zero mass carriers in graphene *Science* **324** 924–7
[247] Song Y J, Otte A F, Kuk Y, Hu Y, Torrance D B and First P N *et al* 2010 High-resolution tunnelling spectroscopy of a graphene quartet *Nature* **467** 185–9
[248] Jung S, Rutter G M, Klimov N N, Newell D B, Calizo I and Hight-Walker A R *et al* 2011 Evolution of microscopic localization in graphene in a magnetic field from scattering resonances to quantum dots *Nat. Phys.* **7** 245–51
[249] Chae J, Jung S, Young A F, Dean C R, Wang L and Gao Y *et al* 2012 Renormalization of the graphene dispersion velocity determined from scanning tunneling spectroscopy *Phys. Rev. Lett.* **109** 116802
[250] Li G, Luican A and Andrei E Y 2009 Scanning tunneling spectroscopy of graphene on graphite *Phys. Rev. Lett.* **102** 176804
[251] Rutter G M, Jung S, Klimov N N, Newell D B, Zhitenev N B and Stroscio J A 2011 Microscopic polarization in bilayer graphene *Nat. Phys.* **7** 649–55
[252] Miller D L, Kubista K D, Rutter G M, Ruan M, de Heer W A and Kindermann M *et al* 2010 Real-space mapping of magnetically quantized graphene states *Nat. Phys.* **6** 811–7
[253] Hashimoto K, Champel T, Florens S, Sohrmann C, Wiebe J and Hirayama Y *et al* 2012 Robust nodal structure of Landau level wave functions revealed by Fourier transform scanning tunneling spectroscopy *Phys. Rev. Lett.* **109** 116805
[254] Fu Y S, Kawamura M, Igarashi K, Takagi H, Hanaguri T and Sasagawa T 2014 Imaging the two-component nature of Dirac–Landau levels in the topological surface state of Bi_2Se_3 *Nat. Phys.* **10** 815–9
[255] Chang C P, Lu C L, Shyu F L, Chen R B, Huang Y C and Lin M F 2005 Magnetoelectronic properties of AB-stacked graphite *Carbon* **43** 1424–31

[256] Lu C L, Chang C P and Lin M F 2007 Magneto-electronic properties of AA- and ABC-stacked graphites *Eur. Phys. J.* B **60** 161–9

Chapter 2

[1] Wallace P R 1947 The band theory of graphite *Phys. Rev.* **71** 622–34
[2] Ou Y C, Chiu Y H, Yang P H and Lin M F 2014 The selection rule of graphene in a composite magnetic field *Opt. Exp.* **22** 7473–91
[3] Ho J H, Lu C L, Hwang C C, Chang C P and Lin M F 2006 Coulomb excitations in AA- and AB-stacked bilayer graphites *Phys. Rev.* B **74** 085406
[4] Ho J H, Chang C P and Lin M F 2005 Electronic excitations of the multilayered graphite *Phys. Lett.* A **352** 446–50
[5] Lin M F, Chuang Y C and Wu J Y 2012 Electrically tunable plasma excitations in AA-stacked multilayer graphene *Phys. Rev.* B **86** 125434
[6] Wu J Y, Chen S C, Roslyak O, Gumbs G and Lin M F 2011 Plasma excitations in graphene: their spectral intensity and temperature dependence in magnetic field *ACS Nano* **5** 1026–32
[7] Lozovik Y E and Sokolik A A 2012 Influence of Landau level mixing on the properties of elementary excitations in graphene in strong magnetic field *Nano. Res. Lett.* **7** 134
[8] Wu J Y, Gumbs G and Lin M F 2014 Combined effect of stacking and magnetic field on plasmon excitations in bilayer graphene *Phys. Rev.* B **89** 165407
[9] Wu J Y, Lin C Y, Gumbs G and Lin M F 2015 The effect of perpendicular electric field on temperature-induced plasmon excitations for intrinsic silicene *RSC Adv.* **5** 51912–8
[10] Do T N, Lin C Y, Lin Y P, Shih P H and Lin M F 2015 Configuration-enriched magneto-electronic spectra of AAB-stacked trilayer graphene *Carbon* **94** 619–32
[11] Huang Y K, Chen S C, Ho Y H, Lin C Y and Lin M F 2014 Feature-rich magnetic quantization in sliding bilayer graphenes *Sci. Rep.* **4** 7509
[12] Lin C Y, Wu J Y, Ou Y J, Chiu Y H and Lin M F 2015 Magneto-electronic properties of multilayer graphenes *Phys. Chem. Chem. Phys.* **17** 26008–35
[13] Lin C Y, Wu J Y, Chiu Y H, Chang C P and Lin M F 2014 Stacking-dependent magnetoelectronic properties in multilayer graphene *Phys. Rev.* B **90** 205434

Chapter 3

[1] Lee J K, Lee S C, Ahn J P, Kim S C, Wilson J I B and John P 2008 The growth of AA graphite on (1 1 1) diamond *J. Chem. Phys.* **129** 234709
[2] Lobato I and Partoens B 2011 Multiple Dirac particles in AA-stacked graphite and multilayers of graphene *Phys. Rev.* B **83** 165429
[3] Shyu F L and Lin M F 2001 Low-frequency π-electronic excitations of simple hexagonal graphite *J. Phys. Soc. Jpn* **70** 897–901
[4] Lin M F, Huang C S and Chuu D S 1997 Plasmons in graphite and stage-1 graphite intercalation compounds *Phys. Rev.* B **55** 13961
[5] Lin M F, Chuu D S, Huang C S, Lin Y K and Shung K W K 1996 Collective excitations in a single-layer carbon nanotube *Phys. Rev.* B **53** 15493
[6] Lin M F, Shyu F L and Chen R B 2000 Optical properties of well-aligned multiwalled carbon nanotube bundles *Phys. Rev.* B **61** 14114
[7] Watzel J, Pavlyukh Y, Schaffer A and Berakdar J 2016 Optical vortex driven charge current loop and optomagnetism in fullerenes *Carbon* **99** 439–43

[8] Charlier J C, Michenaud J P and Gonze X 1992 First-principles study of the electronic properties of simple hexagonal graphite *Phys. Rev.* B **46** 4531–9
[9] Chang C P 2011 Exact solution of the spectrum and magneto-optics of multilayer hexagonal graphene *J. Appl. Phys.* **110** 013725
[10] Kim K S, Walter A L, Moreschini L, Seyller T, Horn K and Rotenberg E *et al* 2013 Coexisting massive and massless Dirac fermions in symmetry-broken bilayer graphene *Nat. Mater.* **12** 887–92
[11] Ho J H, Lu C L, Hwang C C, Chang C P and Lin M F 2006 Coulomb excitations in AA- and AB-stacked bilayer graphites *Phys. Rev.* B **74** 085406
[12] Chiu C W, Chen S C, Huang Y C, Shyu F L and Lin M F 2013 Critical optical properties of AA-stacked multilayer graphenes *Appl. Phys. Lett.* **103** 041907
[13] Tsai S J, Chiu Y H, Ho Y H and Lin M F 2012 Gate-voltage-dependent Landau levels in AA-stacked bilayer graphene *Chem. Phys. Lett.* **550** 104–10
[14] Gerhardts R R, Weiss D and Vonklitzing K 1989 Novel magnetoresistance oscillations in a periodically modulated two-dimensional electron gas *Phys. Rev. Lett.* **62** 1173
[15] Terashima T, Kikugawa N, Kiswandhi A, Choi E S, Brooks J S and Kasahara S *et al* 2014 Anomalous Fermi surface in FeSe seen by Shubnikov-de Haas oscillation measurements *Phys. Rev.* B **90** 144517
[16] Zudov M A, Du R R, Simmons J A and Reno J L 2013 Shubnikov-de Haas-like oscillations in millimeterwave photoconductivity in a high-mobility two-dimensional electron gas *Phys. Rev.* B **64** 201311
[17] Ho Y H, Wu J Y, Chen R B and Lin M F 2010 Optical transitions between Landau levels: AA-stacked bilayer graphene *App. Phys. Lett.* **97** 101905
[18] Koshino M and Ando T 2008 Magneto-optical properties of multilayer graphene *Phys. Rev.* B **77** 115313
[19] Abergel D S L and Fal'ko V I 2007 Optical and magneto-optical far-infrared properties of bilayer graphene *Phys. Rev.* B **75** 155430
[20] Ho Y H, Chiu Y H, Lin D H, Chang C P and Lin M F 2010 Magneto-optical selection rules in bilayer Bernal graphene *ACS Nano* **4** 1465–72
[21] Kim K S, Walter A L, Moreschini L, Seyller T, Horn K and Rotenberg E *et al* 2013 Coexisting massive and massless Dirac fermions in symmetry-broken bilayer graphene *Nat. Mat.* **12** 887–92
[22] Berciaud S, Potemski M and Faugeras C 2014 Probing electronic excitations in mono- to pentalayer graphene by micro magneto-Raman spectroscopy *Nano Lett.* **14** 4548–53

Chapter 4

[1] Min H and MacDonald A H 2008 Electronic structure of multilayer graphene *Prog. Theor. Phys. Supplement* **176** 227–52
[2] Gruneis A, Attaccalite C, Wirtz L, Shiozawa H, Saito R and Pichler T *et al* 2008 Tight-binding description of the quasiparticle dispersion of graphite and few-layer graphene *Phys. Rev.* B **78** 205425
[3] Aoki M and Amawash H 2007 Dependence of band structures on stacking and field in layered graphene *Solid State Commun.* **142** 123–7
[4] Avetisyan A A, Partoens B and Peeters F M 2010 Stacking order dependent electric field tuning of the band gap in graphene multilayers *Phys. Rev.* B **81** 115432

[5] Bao W, Jing L, Velasco J, Lee Y, Liu G and Tran D *et al* 2011 Stacking-dependent band gap and quantum transport in trilayer graphene *Nat. Phys.* **7** 948–52
[6] Coletti C, Forti S, Principi A, Emtsev K V, Zakharov A A and Daniels K M *et al* 2013 Revealing the electronic band structure of trilayer graphene on SiC: an angle-resolved photoemission study *Phys. Rev.* B **88** 155439
[7] Lui C H, Li Z, Mak K F, Cappelluti E and Heinz T F 2102 Observation of an electrically tunable band gap in trilayer graphene *Nat. Phys.* **7** 944–7
[8] Ohta T, Bostwick A and McChesney J L 2007 Interlayer interaction and electronic screening in multilayer graphene investigated with angle-resolved photoemission spectroscopy *Phys. Rev. Lett.* **98** 206802
[9] Mak K F, Shan J and Heinz T F 2010 Electronic structure of few-layer graphene: experimental demonstration of strong dependence on stacking sequence *Phys. Rev. Lett.* **104** 176404
[10] Zhang L M, Li Z Q, Basov D N, Fogler M M, Hao Z and Martin M C 2008 Determination of the electronic structure of bilayer graphene from infrared spectroscopy *Phys. Rev.* B **78** 235408
[11] Li Z Q, Henriksen E A, Jiang Z, Hao Z, Martin M C and Kim P *et al* 2009 Band structure asymmetry of bilayer graphene revealed by infrared spectroscopy *Phys. Rev. Lett.* **102** 037403
[12] Kuzmenko A B, van Heumen E, van der Marel D, Lerch P, Blake P and Novoselov K S *et al* 2009 Infrared spectroscopy of electronic bands in bilayer graphene *Phys. Rev.* B **79** 115441
[13] Berciaud S, Potemski M and Faugeras C 2014 Probing electronic excitations in mono- to pentalayer graphene by micro magneto-raman spectroscopy *Nano Lett.* **14** 4548–53
[14] Zhang Y, Tang T T, Girit C, Hao Z, Martin M C and Zettl A *et al* 2009 Direct observation of a widely tunable bandgap in bilayer graphene *Nature* **459** 820–3
[15] Li Z Q, Henriksen E A, Jiang Z, Hao Z, Martin M C and Kim P *et al* 2008 Dirac charge dynamics in graphene by infrared spectroscopy *Nat. Phys.* **4** 532–5
[16] Wang F, Zhang Y, Tian C, Girit C, Zettl A and Crommie M *et al* 2008 Gate-variable optical transitions in graphene *Science* **320** 206–9
[17] Kim D S, Kwon H, Nikitin A Y, Ahn S, Martin-Moreno L and Garcia-Vidal F J *et al* 2015 Stacking structures of few-layer graphene revealed by phase-sensitive infrared nanoscopy *ACS Nano* **9** 6765–73
[18] Lu C L, Chang C P, Huang Y C, Chen R B and Lin M L 2006 Influence of an electric field on the optical properties of few-layer graphene with AB stacking *Phys. Rev.* B **73** 144427
[19] McCann E 2006 Asymmetry gap in the electronic band structure of bilayer graphene *Phys. Rev.* B **74** 161403
[20] Kumar S B and Guo J 2011 Multilayer graphene under vertical electric field *App. Phy. Lett* **98** 222101
[21] Avetisyan A A, Partoens B and Peeters F M 2009 Electric field tuning of the band gap in graphene multilayers *Phys. Rev.* B **79** 035421
[22] Castro E V, Novoselov K S, Morozov S V, Peres N M R, Lopes dos Santos J M B and Nilsson J *et al* 2007 Biased bilayer graphene: Semiconductor with a gap tunable by the electric field effect *Phys. Rev. Lett.* **99** 216802
[23] Yankowitz M, Wang F L, Lau C N and LeRoy B J 2013 Local spectroscopy of the electrically tunable band gap in trilayer graphene *Phys. Rev.* B **87** 165102

[24] Zhang W, Lin C T, Liu K K, Tite T, Su C Y and Chang C H *et al* 2011 Opening electrical band gap of bilayer graphene with molecular doping *ACS Nano* **5** 7517–24
[25] Ho Y H, Chiu Y H, Lin D H, Chang C P and Lin M F 2010 Magneto-optical selection rules in bilayer bernal graphene *ACS Nano* **4** 1465–72
[26] Abergel D S L and Fal'ko V I 2007 Optical and magneto-optical far-infrared properties of bilayer graphene *Phys. Rev.* B **75** 155430
[27] Charlier J C, Gonze X and Michenaud J P 1994 First-principles study of the stacking effect on the electronic-properties of graphite(s) *Carbon* **32** 289–99
[28] Charlier J C, Michenaud J P and Ph Lambin 1992 Tight-binding density of electronic states of pregraphitic carbon *Phys. Rev.* B **46** 4540–3
[29] Lu C L, Chang C P, Huang Y C, Lu J M, Hwang C C and Lin M F 2006 Low-energy electronic properties of the AB-stacked few-layer graphites *J. Phys. Condens. Matter* **18** 5849–59
[30] Craciun M F, Russo S, Yamamoto M, Oostinga J B, Morpurgo A F and Tarucha S 2009 Trilayer graphene is a semimetal with a gate-tunable band overlap *Nat. Nanotechnol.* **4** 383–8
[31] Cherkez V, Trambly de Laissardiere G, Mallet P and Veuillen J Y 2015 Van Hove singularities in doped twisted graphene bilayers studied by scanning tunneling spectroscopy *Phys. Rev.* B **91** 155428
[32] Lee Y, Velasco J, Tran D, Zhang F, Bao W and Jing L *et al* 2013 Broken symmetry quantum Hall states in dual-gated ABA trilayer graphene *Nano Lett.* **13** 1627–31
[33] Henriksen E A, Nandi D and Eisenstein J P 2012 Quantum Hall effect and semimetallic behavior of dual-gated ABA-stacked trilayer graphene *Phys. Rev.* X **2** 011004
[34] Cadden-Zimansky P, Jiang Z, Li Z Q, Tung L C, Schwartz M E and Takita M *et al* 2010 Interaction-induced shift of the cyclotron resonance of graphene using infrared spectroscopy *Phys. Rev. Lett.* **104** 067404
[35] Jiang Z, Henriksen E A, Tung L C, Wang Y J, Schwartz M E and Han M Y *et al* 2007 Infrared spectroscopy of Landau levels of graphene *Phys. Rev. Lett.* **98** 197403
[36] Plochocka P, Faugeras C, Orlita M, Sadowski M L, Martinez G and Potemski M *et al* 2008 High-energy limit of massless Dirac fermions in multilayer graphene using magneto-optical transmission spectroscopy *Phys. Rev. Lett.* **100** 087401
[37] Faugeras C, Amado M, Kossacki P, Orlita M, Kuhne M and Nicolet A A L *et al* 2011 Magneto-Raman scattering of graphene on graphite: electronic and phonon excitations *Phys. Rev. Lett.* **107** 036807
[38] Zhao H M, Lin Y C, Yeh C H, Tian H, Chen Y C and Xie D *et al* 2014 Growth and Raman spectra of single-crystal trilayer graphene with different stacking orientations *ACS Nano* **8** 10766–73
[39] Cong C X, Jung J, Cao B C, Qiu C Y, Shen X N and Ferreira A *et al* 2015 Magnetic oscillation of optical phonon in ABA- and ABC-stacked trilayer graphene *Phys. Rev.* B **91** 235403
[40] Tung L C, Cadden-Zimansky P, Qi J, Jiang Z and Smirnov D 2011 Measurement of graphite tight-binding parameters using high-field magnetoreflectance *Phys. Rev.* B **84** 153405
[41] Plochocka P, Solane P Y, Nicholas R J, Schneider J M, Piot B A and Maude D K *et al* 2012 Origin of electron-hole asymmetry in graphite and graphene *Phys. Rev.* B **85** 245410
[42] Zhang F, Sahu B, Min H and MacDonald A H 2010 Band structure of ABC-stacked graphene trilayers *Phys. Rev.* B **82** 035409

[43] Gusynin V P, Sharapov S G and Carbotte J P 2007 Anomalous absorption line in the magneto-optical response of graphene *Phys. Rev. Lett.* **98** 157402
[44] Koshino M and Ando T 2008 Magneto-optical properties of multilayer graphene *Phys. Rev.* B **77** 115313
[45] Ferrari A C, Meyer J C, Scardaci V, Casiraghi C, Lazzeri M and Mauri F *et al* 2006 Raman spectrum of graphene and graphene layers *Phys. Rev. Lett.* **97** 187401

Chapter 5

[1] Bernal J D 1924 The structure of graphite *Proc. R. Soc. London, Ser.* A **106** 749
[2] Lipson H and Stokes A R 1942 The structure of graphite *Proc. R. Sot. London, Ser.* A **181** 101
[3] Guinea F, Castro Neto A H and Peres N M R 2006 Electronic states and Landau levels in graphene stacks *Phys. Rev.* B **73** 245426
[4] Kopnin N B, Heikkila T T and Volovik G E 2011 High-temperature surface superconductivity in topological flat-band systems *Phys. Rev.* B **83** 220503
[5] Wang H, Gao J H and Zhang F C 2013 Flat band electrons and interactions in rhombohedral trilayer graphene *Phys. Rev.* B **87** 155116
[6] Castro Neto A H, Guinea F, Peres N M R, Novoselov K S and Geim A K 2009 The electronic properties of graphene *Rev. Mod. Phys.* **81** 109–62
[7] Latil S and Henrard L 2006 Charge carriers in few-layer graphene films *Phys. Rev. Lett.* **97** 036803
[8] Xiao R, Tasnadi F, Koepernik K, Venderbos J W F, Richter M and Taut M 2011 Density functional investigation of rhombohedral stacks of graphene: topological surface states, nonlinear dielectric response, and bulk limit *Phys. Rev.* B **84** 165404
[9] Zhang F, Sahu B, Min H and MacDonald A H 2010 Band structure of ABC-stacked graphene trilayers *Phys. Rev.* B **82** 035409
[10] Lui C H, Li Z, Chen Z, Klimov P V, Brus L E and Heinz T F 2011 Imaging stacking order in few-layer graphene *Nano Lett.* **11** 164–9
[11] Mak K F, Shan J and Heinz T F 2010 Electronic structure of few-layer graphene: experimental demonstration of strong dependence on stacking sequence *Phys. Rev. Lett.* **104** 176404
[12] Lin Y P, Lin C Y, Ho Y H, Do T N and Lin M F 2015 Magneto-optical properties of ABC-stacked trilayer graphene *Phys. Chem. Chem. Phys.* **17** 15921–7
[13] Lin Y P, Lin C Y, Chang C P and Lin M F 2015 Electric-field-induced rich magneto-absorption spectra of ABC-stacked trilayer graphene *RSC Adv* **5** 80410
[14] Lin C Y, Wu J Y, Chiu Y H, Chang C P and Lin M F 2014 Stacking-dependent magnetoelectronic properties in multilayer graphene *Phy. Rev.* B **90** 205434
[15] Charlier J C, Michenaud J P and Lambin Ph 1992 Tight-binding density of electronic states of pregraphitic carbon *Phys. Rev.* B **46** 4540–3
[16] Koshino M and McCann E 2009 Trigonal warping and Berry's phase $N\pi$ in ABC-stacked multilayer graphene *Phys. Rev.* B **80** 165409
[17] Yankowitz M, Wang F L, Lau C N and LeRoy B J 2013 Local spectroscopy of the electrically tunable band gap in trilayer graphene *Phys. Rev.* B **87** 165102
[18] Bao W, Jing L, Velasco J, Lee Y, Liu G and Tran D *et al* 2011 Stacking-dependent band gap and quantum transport in trilayer graphene *Nat. Phys.* **7** 948–52

[19] Craciun M F, Russo S, Yamamoto M, Oostinga J B, Morpurgo A F and Tarucha S 2009 Trilayer graphene is a semimetal with a gate-tunable band overlap *Nat. Nanotechnol.* **4** 383–8
[20] Ho C H, Ho Y H, Chiu Y H, Chen Y N and Lin M F 2011 Magneto-electronic properties of rhombohedral trilayer graphene: Peierls tight-binding model *Ann. Phys.* **326** 721–39
[21] Henriksen E A, Nandi D and Eisenstein J P 2012 Quantum Hall effect and semimetallic behavior of dual-gated ABA-stacked trilayer graphene *Phys. Rev.* X **2** 011004
[22] Koshino M and McCann E 2011 Landau level spectra and the quantum Hall effect of multilayer graphene *Phys. Rev.* B **83** 165443
[23] Lin Y P, Wang J, Lu J M, Lin C Y and Lin M F 2014 Energy spectra of ABC-stacked trilayer graphene in magnetic and electric fields *RSC Adv.* **4** 56552–60
[24] Inoue M 1962 Landau levels and cyclotron resonance in graphite *J. Phys. Soc. Jpn* **17** 808
[25] Ho Y H, Chiu Y H, Lin D H, Chang C P and Lin M F 2010 Magneto-optical selection rules in bilayer Bernal graphene *ACS Nano.* **4** 1465–72
[26] Lui C H, Li Z, Mak K F, Cappelluti E and Heinz T F 2102 Observation of an electrically tunable band gap in trilayer graphene *Nat. Phys.* **7** 944–7
[27] Avetisyan A A, Partoens B and Peeters F M 2009 Electric field tuning of the band gap in graphene multilayers *Phys. Rev.* B **79** 035421
[28] Lu C L, Chang C P, Huang Y C, Lu J M, Hwang C C and Lin M F 2006 Low-energy electronic properties of the AB-stacked few-layer graphites *J. Phys.: Condens. Matter* **18** 5849–59
[29] McCann E 2006 Asymmetry gap in the electronic band structure of bilayer graphene *Phys. Rev.* B **74** 161403
[30] Kumar A, Escoffier W, Poumirol J M, Faugeras C, Arovas D P and Fogler M M *et al* 2011 Integer quantum Hall effect in trilayer graphene *Phys. Rev. Lett.* **107** 126806
[31] van Elferen H J, Veligura A, Tombros N, Kurganova E V, van Wees B J and Maan J C *et al* 2013 Fine structure of the lowest Landau level in suspended trilayer graphene *Phys. Rev.* B **88** 121302
[32] Zhang L, Zhang Y, Camacho J, Khodas M and Zaliznyak I 2011 The experimental observation of quantum Hall effect of $l = 3$ chiral quasiparticles in trilayer graphene *Nat. Phys.* **7** 953–7

Chapter 6

[1] Rong Z Y and Kuiper P 1993 Electronic effects in scanning tunneling microscopy: Moiré pattern on a graphite surface *Phys. Rev.* B **48** 17427
[2] Xu P, Xu P, Yang Y, Qi D, Barber S D, Schoelz J K and Ackerman M L *et al* 2012 Electronic transition from graphite to graphene via controlled movement of the top layer with scanning tunneling microscopy *Phys. Rev.* B **86** 085428
[3] Rong Z Y 1994 Extended modifications of electronic structures caused by defects: scanning tunneling microscopy of graphite *Phys. Rev.* B **50** 1839–43
[4] Pong W T, Bendall J and Durkan C 2007 Observation and investigation of graphite superlattice boundaries by scanning tunneling microscopy *Surf. Sci.* **601** 498
[5] Campanera J M, Savini G, Suarez-Martinez I and Heggie M I 2007 Density functional calculations on the intricacies of Moiré patterns on graphite *Phys. Rev.* B **75** 235449
[6] Kazemi A S, Crampin S and A Ilie 2013 Stacking-dependent superstructures at stepped armchair interfaces of bilayer/trilayer graphene *Appl. Phys. Lett.* **102** 163111

[7] Biedermann L B, Bolen M L, Capano M A, Zemlyanov D and Reifenberger R G 2009 Insights into few-layer epitaxial graphene growth on 4H-SiC(000) substrates from STM studies *Phys. Rev.* B **79** 125411
[8] Y Que, Xiao W, Chen H, Wang D, S Du and Gao H J 2015 Stacking-dependent electronic property of trilayer graphene epitaxially grown on Ru(0001) *Appl. Phys. Lett.* **107** 263101
[9] Do T N, Lin C Y, Lin Y P, Shih P H and Lin M F 2015 Configuration-enriched magneto-electronic spectra of AAB-stacked trilayer graphene *Carbon* **94** 619–32
[10] Do T N, Shih P H, Chang C P, Lin C Y and Lin M F 2015 Rich magneto-absorption spectra in AAB-stacked trilayer graphene *Phys. Chem. Chem. Phys* **18** 17597–605
[11] Sprinkle M, Siegel D, Hu Y, Hicks J, Tejeda A and Taleb-Ibrahimi A *et al* 2009 First direct observation of a nearly ideal graphene band structure *Phys. Rev. Lett.* **103** 226803
[12] Gusynin V P, Sharapov S G and Carbotte J P 2007 Anomalous absorption line in the magneto-optical response of graphene *Phys. Rev. Lett.* **98** 157402
[13] Li Z Q, Henriksen E A, Jiang Z, Z Hao, Martin M C and Kim P *et al* 2008 Dirac charge dynamics in graphene by infrared spectroscopy *Nat. Phys.* **4** 532–5
[14] Zhang L M, Li Z Q, Basov D N, Fogler M M, Hao Z and Martin M C 2008 Determination of the electronic structure of bilayer graphene from infrared spectroscopy *Phys. Rev.* B. **78** 235408
[15] Kuzmenko A B, van Heumen E, van der Marel D, Lerch P, Blake P and Novoselov K S *et al* 2009 Infrared spectroscopy of electronic bands in bilayer graphene *Phys. Rev.* B. **79** 115441
[16] Li Z Q, Henriksen E A, Jiang Z, Hao Z, Martin M C and Kim P *et al* 2009 Band structure asymmetry of bilayer graphene revealed by infrared spectroscopy *Phys. Rev. Lett.* **102** 037403
[17] Mak K F, Shan J and Heinz T F 2010 Electronic structure of few-layer graphene: experimental demonstration of strong dependence on stacking sequence *Phys. Rev. Lett.* **104** 176404
[18] Jiang Z, Henriksen E A, Tung L C, Wang Y J, Schwartz M E and M Y Han *et al* 2007 Infrared spectroscopy of Landau levels of graphene *Phys. Rev. Lett.* **98** 197403
[19] Daboussi A, Mandhour L, Fuchs J N and Jaziri S 2014 Tunable zero-energy transmission resonances in shifted graphene bilayer *Phys. Rev.* B **89** 085426
[20] Plochocka P, Faugeras C, Orlita M, Sadowski M L, Martinez G and Potemski M *et al* 2008 High-energy limit of massless Dirac fermions in multilayer graphene using magneto-optical transmission spectroscopy *Phys. Rev. Lett.* **100** 087401
[21] Kim D S, Kwon H, Nikitin A Y, Ahn S, Martin-Moreno L and Garcia-Vidal F J *et al* 2015 Stacking structures of few-layer graphene revealed by phase-sensitive infrared nanoscopy *ACS Nano* **9** 6765–73
[22] Faugeras C, Amado M, Kossacki P, Orlita M, Kuhne M and Nicolet A A L *et al* 2011 Magneto-Raman scattering of graphene on graphite: electronic and phonon excitations *Phys. Rev. Lett.* **107** 036807
[23] Zhang X, Han W P, Qiao X F, Tan Q H, Wang Y F and Zhang J *et al* 2016 Raman characterization of AB- and ABC-stacked few-layer graphene by interlayer shear modes *Carbon* **99** 118–22
[24] Raghavan S, Denig T J, Nelson T C, Chaudhari S and Stinespring C D 2016 Characterization of graphene-on-insulator films formed using plasma based surface chemistry *Carbon* **99** 212–21

[25] Ferrari A C, Meyer J C, Scardaci V, Casiraghi C, Lazzeri M and Mauri F *et al* 2006 Raman spectrum of graphene and graphene layers *Phys. Rev. Lett.* **97** 187401
[26] Nyakiti L O, Myers-Ward R L, Wheeler V D, Imhoff E A, Bezares F J and Chun H *et al* 2012 Bilayer graphene grown on 4H-SiC (0001) step-free mesas *Nano Lett.* **12** 1749–56
[27] Lui C H, Li Z, Chen Z, Klimov P V, Brus L E and Heinz T F 2011 Imaging stacking order in few-layer graphene *Nano Lett.* **11** 164–9
[28] Cancado L G, Takai K, Enoki T, Endo M, Kim Y A and Mizusaki H *et al* 2008 Measuring the degree of stacking order in graphite by Raman spectroscopy *Carbon* **46** 272–5
[29] Zhao H M, Lin Y C, Yeh C H, Tian H, Chen Y C and Xie D *et al* 2014 Growth and Raman spectra of single-crystal trilayer graphene with different stacking orientations *ACS Nano* **8** 10766–73
[30] Berciaud S, Potemski M and Faugeras C 2014 Probing electronic excitations in mono- to pentalayer graphene by micro magneto-Raman spectroscopy *Nano Lett.* **14** 4548–53
[31] Faugeras C, Binder J, Nicolet A A L, Leszczynski P, Kossacki P and Wysmolek A *et al* 2014 A micro-magneto-Raman scattering study of graphene on a bulk graphite substrate *EPL* **108** 27011
[32] Fang W, Hsu A L, Caudillo R, Song Y, Birdwell A G and Zakar E *et al* 2013 Rapid identification of stacking orientation in isotopically labeled chemical-vapor grown bilayer graphene by Raman spectroscopy *Nano Lett.* **13** 1541–8
[33] Poncharal P, Ayari A, Michel T and Sauvajol J L 2008 Raman spectra of misoriented bilayer graphene *Phys. Rev.* B **78** 113407
[34] Malard L M, Nilsson J, Elias D C, Brant J C, Plentz F and Alves E S *et al* 2007 Probing the electronic structure of bilayer graphene by Raman scattering *Phys. Rev.* B **76** 201401
[35] Xie L M, Wang H L, Jin C H, Wang X R, Jiao L Y and Suenaga K *et al* 2011 Graphene nanoribbons from unzipped carbon nanotubes: atomic structures, Raman spectroscopy, and electrical properties *J. Am. Chem. Soc.* **133** 10394–7
[36] Cherkez V, Trambly de Laissardiere G, Mallet P and Veuillen J Y 2015 Van Hove singularities in doped twisted graphene bilayers studied by scanning tunneling spectroscopy *Phys. Rev.* B **91** 155428
[37] Ohta T, Bostwick A and McChesney J L 2007 Interlayer interaction and electronic screening in multilayer graphene investigated with angle-resolved photoemission spectroscopy *Phys. Rev. Lett.* **98** 206802

Chapter 7

[1] Daboussi A, Mandhour L, Fuchs J N and Jaziri S 2014 Tunable zero-energy transmission resonances in shifted graphene bilayer *Phys. Rev.* B **89** 085426
[2] Kim K S, Walter A L, Moreschini L, Seyller T, Horn K and Rotenberg E *et al* 2013 Coexisting massive and massless Dirac fermions in symmetry-broken bilayer graphene *Nat. Mater.* **12** 887–92
[3] Fang W, Hsu A L, Caudillo R, Song Y, Birdwell A G and Zakar E *et al* 2013 Rapid identification of stacking orientation in isotopically labeled chemical-vapor grown bilayer graphene by Raman spectroscopy *Nano Lett.* **13** 1541–8
[4] Popov A M, Lebedeva I V, Knizhnik A A, Lozovik Y E and Potapkin B V 2011 Commensurate-incommensurate phase transition in bilayer graphene *Phys. Rev.* B **84** 045404

[5] Perebeinos V, Tersoff J and Avouris P 2012 Phonon-mediated interlayer conductance in twisted graphene bilayers *Phys. Rev. Lett.* **109** 236604
[6] Cocemasov A I, Nika D L and Balandin A A 2013 Phonons in twisted bilayer graphene *Phys. Rev.* B **88** 035428
[7] Poncharal P, Ayari A, Michel T and Sauvajol J L 2008 Raman spectra of misoriented bilayer graphene *Phys. Rev.* B **78** 113407
[8] Zheng J, Guo P, Ren Z, Jiang Z, Bai J and Zhang Z 2012 Conductance fluctuations as a function of sliding motion in bilayer graphene nanoribbon junction: a first-principles investigation *Appl. Phys. Lett.* **101** 083101
[9] Son Y W, Choi S M, Hong Y P, Woo S and Jhi S H 2011 Electronic topological transition in sliding bilayer graphene *Phys. Rev.* B **84** 155410
[10] Lee K W and Lee C E 2015 Extreme sensitivity of the electric field-induced band gap to the electronic topological transition in sliding bilayer graphene *Sci. Rep.* **5** 17490
[11] Lopes dos Santos J M B, Peres N M R and Castro Neto A H 2007 Graphene bilayer with a twist: electronic structure *Phys. Rev. Lett.* **99** 256802
[12] Bhattacharyya S and Singh A K 2016 Lifshitz transition and modulation of electronic and transport properties of bilayer graphene by sliding and applied normal compressive strain *Carbon* **99** 432–8
[13] Lei Y, Jiang W, Dai X, Song R, Wang B and Gao Y *et al* 2015 Slippage in stacking of graphene nanofragments induced by spin polarization *Sci. Rep.* **5** 10985
[14] Wong J H, Wu B R and Lin M F 2012 Strain effect on the electronic properties of single layer and bilayer graphene *J. Phys. Chem.* C **116** 8271–7
[15] Tran N T T, Lin S Y, Glukhova O E and Lin M F 2015 Configuration-induced rich electronic properties of bilayer graphene *J Phys. Chem.* C **119** 10623–30
[16] Feng X, Kwon S, Park J Y and Salmeron M 2013 Superlubric sliding of graphene nanoflakes on graphene *ACS Nano* **7** 1718–24
[17] Alden J S, Tsen A W, Huang P Y, Hovden R, Brown L and Park J *et al* 2013 Strain solitons and topological defects in bilayer graphene *Proc. Natl Acad. Sci. USA* **110** 11256–60
[18] Liu Z, Yang J R, Grey F, Liu J Z, Liu Y L and Wang Y B *et al* 2012 Observation of microscale superlubricity in graphite *Phys. Rev. Lett.* **108** 205503
[19] Lebedeva I V, Knizhnik A A, Popov A M, Ershova O V, Lozovik Y E and Potapkin B V 2010 Fast diffusion of a graphene flake on a graphene layer *Phys. Rev.* B **82** 155460
[20] Koshino M 2013 Electronic transmission through AB–BA domain boundary in bilayer graphene *Phys. Rev.* B **88** 115409
[21] Nemec N and Cuniberti G 2007 Hofstadter butterflies of bilayer graphene *Phys. Rev.* B **75** 201404
[22] Chen S C, Chiu C W, Wu C L and Lin M F 2014 Shift-enriched optical properties in bilayer graphene *RSC Adv.* **4** 63779–83
[23] Huang Y K, Chen S C, Ho Y H, Lin C Y and Lin M F 2014 Feature-rich magnetic quantization in sliding bilayer graphenes *Sci. Rep.* **4** 7509
[24] Saito R, Dresselhaus G and Dresselhaus M S 1993 Electronic structure of double layer graphene tubules *J. Appl. Phys.* **73** 494–500
[25] Charlier J C and Michenaud J P 1993 Energetics of multilayered carbon tubules *Phys. Rev. Lett.* **70** 1858–61
[26] Koshino M and McCann E 2010 Parity and valley degeneracy in multilayer graphene *Phys. Rev.* B **81** 115315

[27] Mucha-Kruczynski M, Tsyplyatyev O, Grishin A, McCann E, Fal'ko V I and Bostwick A *et al* 2008 Characterization of graphene through anisotropy of constant-energy maps in angle-resolved photoemission *Phys. Rev.* B **77** 195403
[28] Moreau E, Godey S, Wallart X, Razado-Colambo I, Avila J and Asensio M C *et al* 2013 High-resolution angle-resolved photoemission spectroscopy study of monolayer and bilayer graphene on the C-face of SiC *Phys. Rev.* B **88** 075406
[29] Liu Y, Zhang L, Brinkley M K, Bian G, Miller T and Chiang T C 2010 Phonon-induced gaps in graphene and graphite observed by angle-resolved photoemission *Phys. Rev. Lett.* **105** 136804
[30] Ayria P, Nugraha A R T, Hasdeo E H, Czank T R, Tanaka S and Saito R 2015 Photon energy dependence of angle-resolved photoemission spectroscopy in graphene *Phys. Rev.* B **92** 195148
[31] Choi S M, Jhi S H and Son Y W 2015 Anomalous optical phonon splittings in sliding bilayer graphene *ACS nano* **7** 7151–6
[32] Geng B, Horng J, Zhang Y, Tang T T, Park C H and Girit C *et al* 2010 Optical spectroscopy of bilayer graphene *Phys. Status Solidi* B **247** 2931–4
[33] Zhang Y, Tang T T, Girit C, Hao Z, Martin M C and Zettl A *et al* 2009 Direct observation of a widely tunable bandgap in bilayer graphene *Nature* **459** 820–3
[34] Berciaud S, Potemski M and Faugeras C 2014 Probing electronic excitations in mono- to pentalayer graphene by micro magneto-Raman spectroscopy *Nano Lett.* **14** 4548–53
[35] Kuzmenko A B, Crassee I, van der Marel D, Blake P and Novoselov K S 2009 Determination of the gate-tunable band gap and tight-binding parameters in bilayer graphene using infrared spectroscopy *Phys. Rev.* B **80** 165406
[36] Kuzmenko A B, van Heumen E, van der Marel D, Lerch P, Blake P and Novoselov K S *et al* 2009 Infrared spectroscopy of electronic bands in bilayer graphene *Phys. Rev.* B **79** 115441
[38] Zhang L M, Li Z Q, Basov D N, Fogler M M, Hao Z and Martin M C 2008 Determination of the electronic structure of bilayer graphene from infrared spectroscopy *Phys. Rev.* B **78** 235408
[38] Zhang L M, Li Z Q, Basov D N, Fogler M M, Hao Z and Martin M C 2008 Determination of the electronic structure of bilayer graphene from infrared spectroscopy *Phys. Rev.* B **78** 235408
[39] Faugeras C, Berciaud S, Leszczynski P, Henni Y, Nogajewski K and Orlita M *et al* 2015 Landau level spectroscopy of electron–electron interactions in graphene *Phys. Rev. Lett.* **114** 126804
[40] Orlita M, Faugeras C, Barra A L, Martinez G, Potemski M and Basko D M *et al* 2015 Infrared magneto-spectroscopy of two-dimensional and three-dimensional massless fermions: a comparison *J. Appl. Phys.* **117** 112803
[41] Malard L M, Nilsson J, Elias D C, Brant J C, Plentz F and Alves E S *et al* 2007 Probing the electronic structure of bilayer graphene by Raman scattering *Phys. Rev.* B **76** 201401
[42] Ferrari A C, Meyer J C, Scardaci V, Casiraghi C, Lazzeri M and Mauri F *et al* 2006 Raman spectrum of graphene and graphene layers *Phys. Rev. Lett.* **97** 187401
[43] Lu C L, Chang C P, Huang Y C, Chen R B and Lin M L 2006 Influence of an electric field on the optical properties of few-layer graphene with AB stacking *Phys. Rev.* B **73** 144427
[44] Maka K F, Sfeirb M Y, Misewichb J A and Heinza T F 2010 The evolution of electronic structure in few-layer graphene revealed by optical spectroscopy *Proc. Natl Acad. Sci. USA* **107** 14999–15004

[45] Kim D S, Kwon H, Nikitin A Y, Ahn S, Martin-Moreno L and Garcia-Vidal F J *et al* 2015 Stacking structures of few-layer graphene revealed by phase-sensitive infrared nanoscopy *ACS Nano* **9** 6765–73
[46] Liou S C, Shie C S, Chen C H, Breitwieser R, Pai W W and Guo G Y *et al* 2015 π-plasmon dispersion in free-standing graphene by momentum-resolved electron energy-loss spectroscopy *Phys. Rev.* B **91** 045418
[47] McCann E and Fal'ko V I 2006 Landau-level degeneracy and quantum Hall effect in a graphite bilayer *Phys. Rev. Lett.* **96** 086805
[48] Matsui T, Kambara H, Niimi Y, Tagami K, Tsukada M and Fukuyama H 2005 STS observations of Landau levels at graphite surfaces *Phys. Rev.* B **94** 226403
[49] Uchoa B, Yang L, Tsai S W, Peres N M and Rm Castro Neto A H 2009 Theory of scanning tunneling spectroscopy of magnetic adatoms in graphene *Phys. Rev. Lett.* **103** 206804
[50] Chae J, Jung S, Young A F, Dean C R, Wang L and Gao Y *et al* 2012 Renormalization of the graphene dispersion velocity determined from scanning tunneling spectroscopy *Phys. Rev. Lett.* **109** 116802
[51] Li G, Luican A and Andrei E Y 2009 Scanning tunneling spectroscopy of graphene on graphite *Phys. Rev. Lett.* **102** 176804
[52] Faugeras C, Binder J, Nicolet A A L, Leszczynski P, Kossacki P and Wysmolek A *et al* 2014 A micro-magneto-Raman scattering study of graphene on a bulk graphite substrate *EPL* **108** 27011
[53] Tsai S J, Chiu Y H, Ho Y H and Lin M F 2012 Gate-voltage-dependent Landau levels in AA-stacked bilayer graphene *Chem. Phys. Lett.* **550** 104–110
[54] Mak K F, Lui C H, Shan J and Heinz T F 2009 Observation of an electric-field-induced band gap in bilayer graphene by infrared spectroscopy *Phys. Rev. Lett.* **102** 256405
[55] Li X L, Wang X R, Zhang L, Lee S W and Dai H J 2008 Chemically derived, ultrasmooth graphene nanoribbon semiconductors *Science* **319** 1229–32
[56] Fujii S and Enoki T 2010 Cutting of oxidized graphene into nanosized pieces *J. Am. Chem. Soc.* **132** 10034–41
[57] Kosynkin D V, Higginbotham A L, Sinitskii A, Lomeda J R, Dimiev A and Price B K *et al* 2009 Longitudinal unzipping of carbon nanotubes to form graphene nanoribbons *Nature* **458** 872–U5
[58] Jiao L, Zhang L, Wang X, Diankov G and Dai H J 2009 Narrow graphene nanoribbons from carbon nanotubes *Nature* **458** 877–80
[59] Kim K, Sussman A and Zettl 2010 A Graphene nanoribbons obtained by electrically unwrapping carbon nanotubes *ACS Nano* **4** 1362–6
[60] Blankenburg S, Cai J, Ruffieux P, Jaafar R, Passerone D and Feng X *et al* 2012 Intraribbon heterojunction formation in ultranarrow graphene nanoribbons *ACS Nano* **6** 2020–5
[61] Yi Z, Yanfang Z, Geng L, Jianchen L, Xiao L and Shixuan D *et al* 2014 Direct visualization of atomically precise nitrogen-doped graphene nanoribbons *Appl. Phys. Lett.* **105** 023101
[62] Xie L M, Wang H L, Jin C H, Wang X R, Jiao L Y and Suenaga K *et al* 2011 Graphene nanoribbons from unzipped carbon nanotubes: atomic structures, Raman spectroscopy, and electrical properties *J. Am. Chem. Soc.* **133** 10394–7
[63] Chang S L, Wu B R, Wong J H and Lin M F 2014 Configuration-dependent geometric and electronic properties of bilayer graphene nanoribbons *Carbon* **77** 1031–9
[64] Lin M F and Shyu F L 2000 Optical properties of nanographite ribbons *J. Phys. Soc. Jpn* **69** 3529–32

[65] Hsu H and Reichl L E 2007 Selection rule for the optical absorption of graphene nanoribbons *Phys. Rev.* B **76** 045418
[66] Chung H C, Lee M H, Chang C P and Lin M F 2011 Exploration of edge-dependent optical selection rules for graphene nanoribbons *Opt. Express* **19** 23350–63
[67] Sasaki K I, Kato K, Tokura Y, Oguri K and Sogawa T 2010 Theory of optical transitions in graphene nanoribbons *Phys. Rev.* B **84** 085458
[68] Huang Y C, Chang C P and Lin M F 2007 Magnetic and quantum confinement effects on electronic and optical properties of graphene ribbons *Nanotechnology* **18** 495401
[69] Chang C P, Huang Y C, Lu C L, Ho J H, Li T S and Lin M F 2006 Electronic and optical properties of a nanographite ribbon in an electric field *Carbon* **44** 508–15
[70] Chung H C, Chang C P, Lin C Y and Lin M F 2016 Electronic and optical properties of graphene nanoribbons in external fields *Phys. Chem. Chem. Phys.* **18** 7573–616
[71] Soule D E 1958 Magnetic field dependence of the Hall effect and magnetoresistance in graphite single crystals *Phys. Rev* **112** 698–707
[72] Galt J K, Yager W A and Dail H W 1956 Cyclotron resonance effects in graphite *Phys. Rev* **103** 1586–7
[73] Dresselhaus M S and Dresselhaus G 1981 Intercalation compounds of graphite *Adv. Phys* **30** 139–326
[74] Chiu C W, Lee S H, Chen S C, Shyu F L and Lin M F 2010 Absorption spectra of AA-stacked graphite *New J. Phys.* **12** 083060
[75] Chiu C W, Huang Y C, Chen S C, Lin M F and Shyu F L 2011 Low-frequency electronic and optical properties of rhombohedral graphite *Phys. Chem. Chem. Phys.* **13** 6036–42
[76] Chen R B, Chiu Y H and Lin M F 2013 A theoretical evaluation of the magneto-optical properties of AA-stacked graphite *Carbon* **54** 268–76
[77] Chen R B, Chiu Y H and Lin M F 2015 Beating oscillations of magneto-optical spectra in simple hexagonal graphite *Comput. Phys. Commun.* **189** 60–5
[78] Nakao K 1976 Landau level structure and magnetic breakthrough in graphite *J. Phys. Soc. Jpn.* **40** 761–8
[79] Ho Y H, Wang J, Chiu Y H, Lin M F and Su W P 2011 Characterization of Landau subbands in graphite: a tight-binding study *Phys. Rev.* B **83** 121201
[80] Ho C H, Chang C P and Lin M F 2013 Precessing anisotropic Dirac cone and Landau subbands along a nodal spiral *New J. Phys.* **15** 053032
[81] Ho C H, Chang C P and Lin M F 2015 Optical magnetoplasmons in rhombohedral graphite with a three-dimensional dirac cone structure *J. Phys. Condens. Matter* **27** 125602
[82] Aufray B, Kara A, Vizzini S, Oughaddou H, Leandri C and Ealet B *et al* 2010 Graphene-like silicon nanoribbons on Ag(110): a possible formation of silicene *Appl. Phys. Lett.* **96** 183102
[83] Lalmi B, Oughaddou H, Enriquez H, Kara A, Vizzini S and Ealet B *et al* 2010 Epitaxial growth of a silicene sheet *Appl. Phys. Lett.* **97** 223109
[84] Vogt P, de Padova P, Quaresima C, Avila J, Frantzeskakis E and Asensio M C *et al* 2012 Silicene: compelling experimental evidence for graphenelike two-dimensional silicon *Phys. Rev. Lett.* **108** 155501
[85] Bianco E, Butler S, Jiang S, Restrepo O, Windl W and Goldberger J 2013 Stability and exfoliation of germanane: a germanium graphane analogue *ACS Nano* **7** 4414–21
[86] Chu J H, Kwak J, Kim S D, Lee M J, Kim J J and Park S D *et al* 2014 Monolithic graphene oxide sheets with controllable composition *Nature Comm.* **5** 3383

[87] Derivaz M, Dentel D, Stephan R, Hanf M C, Mehdaoui A and Sonnet P *et al* 2015 Continuous germanene layer on A(111) *Nano Lett.* **15** 2510–6
[88] Zhu F F, Chen W J, Xu Y, Gao C L, Guan D D and Liu C H *et al* 2015 Epitaxial growth of two-dimensional stanene *Nat. Mater.* **14** 1020
[89] Sun Z, Hasan T, Torrisi F, Popa D, Privitera G and Wang F *et al* 2010 Graphene mode-locked ultrafast laser *ACS Nano* **4** 803–10
[90] Tao L, Cinquanta E, Chiappe D, Grazianetti C, Fanciulli M and Dubey M *et al* 2015 Silicene field-effect transistors operating at room temperature *Nat. Nanotech.* **10** 227–31
[91] Tsai W F, Huang C Y, Chang T R, Lin H, Jeng H T and Bansil A 2013 Gated silicene as a tunable source of nearly 100 percent spin-polarized electrons *Nat. Commun.* **4** 1500
[92] Chen S C, Wu C L, Wu J Y and Lin M F 2016 Novel magnetic quantization of sp^3 bonding in monolayer tinene *Phys. Rev.* B **94** 045410
[93] Chang C P, Lu C L, Shyu F L, Chen R B, Huang Y C and Lin M F 2005 Magnetoelectronic properties of AB-stacked graphite *Carbon* **43** 1424–31
[94] Lu C L, Chang C P and Lin M F 2007 Magneto-electronic properties of AA- and ABC-stacked graphites *Eur. Phys. J.* B **60** 161–9
[95] Shyu F L and Lin M F 2001 Low-frequencyπ-electronic excitations of simple hexagonal graphite *J. Phys. Soc. Jpn* **70** 897–901
[96] Lin M F, Huang C S and Chuu D S 1997 Plasmons in graphite and stage-1 graphite intercalation compounds *Phys. Rev.* B **55** 13961
[97] Lin M F, Chuu D S, Huang C S, Lin Y K and Shung K W K 1996 Collective excitations in a single-layer carbon nanotube *Phys. Rev.* B **53** 15493
[98] Lin M F, Shyu F L and Chen R B 2000 Optical properties of well-aligned multiwalled carbon nanotube bundles *Phys. Rev.* B **61** 14114
[99] Watzel J, Pavlyukh Y, Schaffer A and Berakdar J 2016 Optical vortex driven charge current loop and optomagnetism in fullerenes *Carbon* **99** 439–3

Chapter 8

[1] Foa Torres L E F, Perez-Piskunow P M, Balseiro C A and Usaj G 2014 Multiterminal conductance of a Floquet topological insulator Phys. Rev. Lett.**113** 266801
[2] Ezawa M 2012 A topological insulator and helical zero mode in silicene under an inhomogeneous electric field *New J. Phys.* **14** 033003
[3] Ezawa M 2012 Valley-polarized metals and quantum anomalous Hall effect in silicene *Phys. Rev. Lett.* **109** 055502
[4] Tai Y Y, Choi H C, Ahmed T, Ting C S and Zhu J X 2015 Edge states and local electronic structure around an adsorbed impurity in a topological superconductor *Phys. Rev.* B **92** 174514
[5] Li M Y, Shi Y, Cheng C C, Lu L S, Lin Y C and Tang H L *et al* 2015 Epitaxial growth of a monolayer WSe_2-MoS_2 lateral p-n junction with an atomically sharp interface *Science* **349** 524–58
[6] Ho Y H, Wang Y H and Chen H Y 2014 Magnetoelectronic and optical properties of a MoS_2 monolayer *Phys. Rev.* B **89** 155316
[7] Ho Y H, Chiu C W and Lin M F 2014 Magneto-optical spectra of transition metal dichalcogenides: a comparative study *Appl. Phys. Lett.* **105** 222411
[8] Tabert C J and Nicol E J 2013 Valley-spin polarization in the magneto-optical response of silicene and other similar 2D crystals *Phys. Rev. Lett.* **110** 197402

[9] Tabert C J and Nicol E J 2013 Magneto-optical conductivity of silicene and other buckled honeycomb lattices *Phys. Rev.* B **88** 085434
[10] Schafgans A A, Post K W, Taskin A A, Ando Y, Qi X L and Chapler B C *et al* 2012 Landau level spectroscopy of surface states in the topological insulator $Bi_{0.91}Sb_{0.09}$ via magneto-optics *Phys. Rev.* B **85** 195440
[11] LaForge A D, Frenzel A, Pursley B C, Lin T, Liu X F and Shi J *et al* 2010 Optical characterization of Bi_2Se_3 in a magnetic field: infrared evidence for magnetoelectric coupling in a topological insulator material *Phys. Rev.* B **81** 125120
[12] Morkoc H, Strite S, Gao G B, Lin M E, Sverdlov B and Burns M 1994 Large-band-gap SiC, III-V nitride, and II-VI ZnSe-based semiconductor-device technologies *J. Appl. Phys* **76** 1363–98
[13] Ando T, Fowler A B and Stern F 1982 Electronic properties of two-dimensional systems *Rev. Mod. Phys.* **54** 437–72
[14] Li X L, Wang X R, Zhang L, Lee S W and Dai H J 2008 Chemically derived, ultrasmooth graphene nanoribbon semiconductors *Science* **319** 1229–32
[15] Fujii S and Enoki T 2010 Cutting of oxidized graphene into nanosized pieces *J. Am. Chem. Soc.* **132** 10034–41
[16] Kosynkin D V, Higginbotham A L, Sinitskii A, Lomeda J R, Dimiev A and Price B K *et al* 2009 Longitudinal unzipping of carbon nanotubes to form graphene nanoribbons *Nature* **458** 872–U5
[17] Jiao L, Zhang L, Wang X, Diankov G and Dai H J 2009 Narrow graphene nanoribbons from carbon nanotubes *Nature* **458** 877–80
[18] Kim K, Sussman A and Zettl A 2010 Graphene nanoribbons obtained by electrically unwrapping carbon nanotubes ACS Nano**4** 1362–6
[19] Blankenburg S, Cai J, Ruffieux P, Jaafar R, Passerone D and Feng X *et al* 2012 Intraribbon heterojunction formation in ultranarrow graphene nanoribbons *ACS Nano* **6** 2020–5
[20] Yi Z, Yanfang Z, Geng L, Jianchen L, Xiao L and Shixuan D *et al* 2014 Direct visualization of atomically precise nitrogen-doped graphene nanoribbons *Appl. Phys. Lett.* **105** 023101
[21] Xie L M, Wang H L, Jin C H, Wang X R, Jiao L Y and Suenaga K *et al* 2011 Graphene nanoribbons from unzipped carbon nanotubes: atomic structures, Raman spectroscopy, and electrical properties *J. Am. Chem. Soc.* **133** 10394–7
[22] Chang S L, Wu B R, Wong J H and Lin M F 2014 Configuration-dependent geometric and electronic properties of bilayer graphene nanoribbons *Carbon* **77** 1031–9
[23] Lin M F and Shyu F L 2000 Optical properties of nanographite ribbons *J. Phys. Soc. Jpn* **69** 3529–32
[24] Hsu H and Reichl L E 2007 Selection rule for the optical absorption of graphene nanoribbons *Phys. Rev.* B **76** 045418
[25] Chung H C, Lee M H, Chang C P and Lin M F 2011 Exploration of edge-dependent optical selection rules for graphene nanoribbons *Opt. Express* **19** 23350–63
[26] Sasaki K I, Kato K, Tokura Y, Oguri K and Sogawa T 2010 Theory of optical transitions in graphene nanoribbons *Phys. Rev.* B **84** 085458
[27] Huang Y C, Chang C P and Lin M F 2007 Magnetic and quantum confinement effects on electronic and optical properties of graphene ribbons *Nanotechnology* **18** 495401
[28] Chang C P, Huang Y C, Lu C L, Ho J H, Li T S and Lin M F 2006 Electronic and optical properties of a nanographite ribbon in an electric field *Carbon* **44** 508–15

[29] Chung H C, Chang C P, Lin C Y and Lin M F 2016 Electronic and optical properties of graphene nanoribbons in external fields *Phys. Chem. Chem. Phys.* **18** 7573–616
[30] Soule D E 1958 Magnetic field dependence of the Hall effect and magnetoresistance in graphite single crystals *Phys. Rev.* **112** 698–707
[31] Galt J K, Yager W A and Dail H W 1956 Cyclotron resonance effects in graphite *Phys. Rev.* **103** 1586–7
[32] Dresselhaus M S and Dresselhaus G 1981 Intercalation compounds of graphite *Adv. Phys.* **30** 139–326
[33] Chiu C W, Lee S H, Chen S C, Shyu F L and Lin M F 2010 Absorption spectra of AA-stacked graphite *New J. Phys.* **12** 083060
[34] Chiu C W, Huang Y C, Chen S C, Lin M F and Shyu F L 2011 Low-frequency electronic and optical properties of rhombohedral graphite *Phys. Chem. Chem. Phys.* **13** 6036–42
[35] Chen R B, Chiu Y H and Lin M F 2013 A theoretical evaluation of the magneto-optical properties of AA-stacked graphite *Carbon* **54** 268–76
[36] Chen R B, Chiu Y H and Lin M F 2015 Beating oscillations of magneto-optical spectra in simple hexagonal graphite *Comput. Phys. Commun.* **189** 60–5
[37] Nakao K 1976 Landau level structure and magnetic breakthrough in graphite *J. Phys. Soc. Jpn* **40** 761–8
[38] Ho Y H, Wang J, Chiu Y H, Lin M F and Su W P 2011 Characterization of Landau subbands in graphite: a tight-binding study *Phys. Rev.* B **83** 121201
[39] Ho C H, Chang C P and Lin M F 2013 Precessing anisotropic Dirac cone and Landau subbands along a nodal spiral *New J. Phys.* **15** 053032
[40] Ho C H, Chang C P and Lin M F 2015 Optical magnetoplasmons in rhombohedral graphite with a three-dimensional Dirac cone structure *J. Phys. Condens. Matter* **27** 125602
[41] Lee J K, Lee S C, Ahn J P, Kim S C, Wilson J I B and John P 2008 The growth of AA graphite on (1 1 1) diamond *J. Chem. Phys.* **129** 234709
[42] Orlita M, Faugeras C, Schneider J M, Martinez G, Maude D K and Potemski M 2009 Graphite from the viewpoint of Landau level spectroscopy: An effective graphene bilayer and monolayer *Phys. Rev. Lett.* **102** 166401
[43] Lipson H and Stokes A R 1942 The structure of graphite *Proc. R. Sot. London, Ser.* A 181 101
[44] Koshino M and Ando T 2008 Magneto-optical properties of multilayer graphene *Phys. Rev.* B **77** 115313
[45] Bae S, Kim H, Lee Y, Xu X, Park J S and Zheng Y *et al* 2010 Roll-to-roll production of 30-inch graphene films for transparent electrodes *Nat. Nanotechnol.* **5** 574–8
[46] Matyba P, Yamaguchi H, Eda G, Chhowalla M, Edman L and Robinson N D 2010 Graphene and mobile ions: the key to all-plastic, solution-processed light-emitting devices *ACS Nano* **4** 637–42
[47] Kusumawati Y, Koussi-Daoud S and Pauporte T 2016 TiO_2/graphene nanocomposite layers for improving the performances of dye-sensitized solar cells using a cobalt redox shuttle *J. Photochem. Photobiol.* **329** 54–60
[48] Xia F N, Mueller T, Lin Y M, Valdes-Garcia A and Avouris P 2009 Ultrafast graphene photodetector *Nat. Nanotechnol.* **4** 839–43
[49] Mueller T, Xia F and Avouris P 2010 Graphene photodetectors for high-speed optical communications *Nat. Photon.* **4** 297–301

[50] Liu M, Yin X B, Ulin-Avila E, Geng B S, Zentgraf T and Ju L *et al* 2011 A graphene-based broadband optical modulator *Nature* **474** 64–7

[51] Liu J B, Li P J, Chen Y F, Song X B, Mao Q and Wu Y *et al* 2016 Flexible terahertz modulator based on coplanar-gate graphene field-effect transistor structure *Optics Lett* **41** 816–9

[52] Aufray B, Kara A, Vizzini S, Oughaddou H, Leandri C and Ealet B *et al* 2010 Graphene-like silicon nanoribbons on Ag(110): a possible formation of silicene *Appl. Phys. Lett.* **96** 183102

[53] Lalmi B, Oughaddou H, Enriquez H, Kara A, Vizzini S and Ealet B *et al* 2010 Epitaxial growth of a silicene sheet *Appl. Phys. Lett.* **97** 223109

[54] Vogt P, de Padova P, Quaresima C, Avila J, Frantzeskakis E and Asensio M C *et al* 2012 Silicene: compelling experimental evidence for graphenelike two-dimensional silicon *Phys. Rev. Lett.* **108** 155501

[55] Bianco E, Butler S, Jiang S, Restrepo O, Windl W and Goldberger J 2013 Stability and exfoliation of germanane: a germanium graphane analogue *ACS Nano* **7** 4414–21

[56] Chu J H, Kwak J, Kim S D, Lee M J, Kim J J and Park S D *et al* 2014 Monolithic graphene oxide sheets with controllable composition *Nature Comm.* **5** 3383

[57] Derivaz M, Dentel D, Stephan R, Hanf M C, Mehdaoui A and Sonnet P *et al* 2015 Continuous germanene layer on A(111) *Nano Lett.* **15** 2510–6

[58] Zhu F F, Chen W J, Xu Y, Gao C L, Guan D D and Liu C H *et al* 2015 Epitaxial growth of two-dimensional stanene *Nat. Mater.* **14** 1020

[59] Sun Z, Hasan T, Torrisi F, Popa D, Privitera G and Wang F *et al* 2010 Graphene mode-locked ultrafast laser *ACS Nano* **4** 803–10

[60] Tao L, Cinquanta E, Chiappe D, Grazianetti C, Fanciulli M and Dubey M *et al* 2015 Silicene field-effect transistors operating at room temperature *Nat. Nanotech.* **10** 227–31

[61] Tsai W F, Huang C Y, Chang T R, Lin H, Jeng H T and Bansil A 2013 Gated silicene as a tunable source of nearly 100 percent spin-polarized electrons *Nat. Commun.* **4** 1500

[62] Chen S C, Wu C L, Wu J Y and Lin M F 2016 Novel magnetic quantization of sp^3 bonding in monolayer tinene *Phys. Rev.* B **94** 045410