EDITORIAL

Luminescent imaging with optical chemical sensors

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Luminescent imaging with optical chemical sensors

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Imaging methods based on photoluminescent molecular probes, nanoprobes or sensor materials are a helpful instrument for numerous application areas such as biomedical research, fluid mechanics, environmental analysis and (micro)process control. Generally, the term ‘molecular imaging’ comprises analytical methods such as advanced x-ray methods (computer tomography), positron emission tomography, magnet resonance imaging or scanning probe microscopy. Biomedical optical imaging is mainly related to fluorescence microscopy. In this case, biomolecules are usually labeled with fluorescent dyes to monitor biomolecular interactions inside cells or at transmembrane bound receptors. Staining and labeling techniques in fluorescence microscopy have been reviewed extensively in the past years [1–3]. However, fluorophores are not only used to label molecules or stain cells and their compartments, they also can act as an indicator (or ‘probe’) to determine intrinsically non-fluorescent species such as O2, pH, CO2, H2O2, Ca2+, or temperature.

The application of luminescent probes exhibits the advantage that they can be delivered directly into the sample, including living cells or tissue, and can be detected in a remote monitoring mode. By now, they are often encapsulated in nanoparticles. Additionally, luminescent sensor materials consisting of probe molecules incorporated into a polymeric support found various applications in biomedical imaging, marine research, process control, or aerodynamics and fluid mechanics. Furthermore, they can be integrated in fiber optic (micro)sensors, microwell plates, or sensor arrays. These types of applications of sensor materials have been reviewed extensively in the past years [4], with particular emphasis on the use of oxygen [5, 6] or pH [7–9] sensitive probes and sensors for biomedical imaging and on temperature sensing [10]. Thus, there was no need to focus once more on these topics.

In fact the intention of this compilation of articles was to introduce brand-new developments in the field of chemical imaging which have not been discussed in previous review articles. These include the design of new sensor nanoparticles based on photon upconversion crystals which convert near-infrared excitation light into sensor signals in the visible wavelength range highlighted by Christ and Schäferling [11], Sun, Ungerböck and Mayr [12] describe the state of the art in oxygen imaging in microreactors and microfluidic devices. Miniaturized sensors for the imaging of oxygen, pH and temperature in microchips, microfluidic platforms and microbioreactors are reviewed by Pfeiffer and Nagl [13]. Furthermore, Dmitriev and Papkovsky [14] present a critical assessment of the applicability of probes for intracellular oxygen sensing.

I hope these articles provide an interesting insight into advanced luminescent sensor materials and the applications of optical micro- and nanosensors in fluorescence imaging today and will be inspiring for the reader. Finally, I would like to thank all authors and referees for spending their time to enable this collection of articles.

References

[9] Shi W, Li X and Ma H 2014 Fluorescent probes and nanoparticles for intracellular sensing of pH values Methods Mol. Biol. 637 311–31