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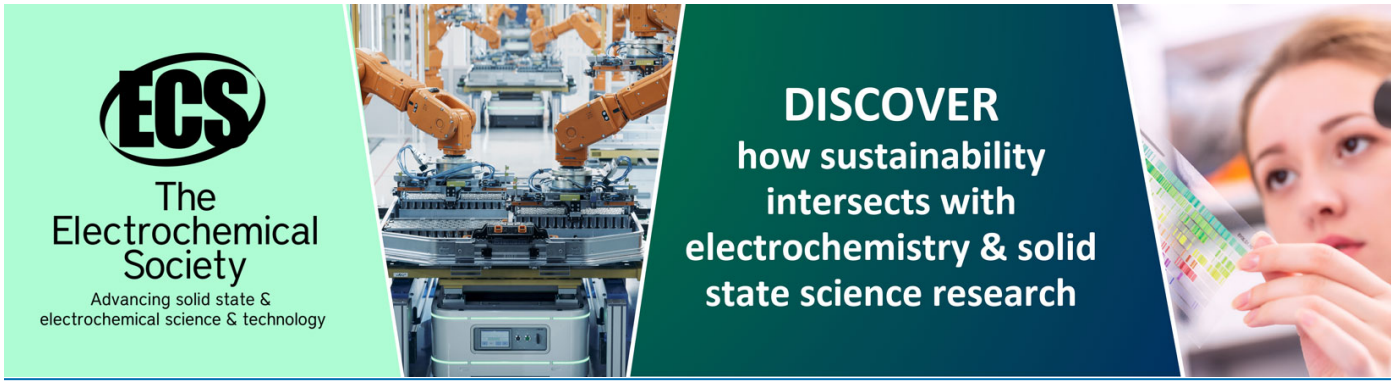

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Attosecond plasmonic streaking from gold nanospheres

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Synopsis To study time-resolved photoemission from gold nanospheres, we introduce a semi-analytical quantum-mechanical model, including the plasmonic near-field-enhancement of the streaking field at the surface of the nanosphere. For an 800 nm incident near infrared (NIR) pulse and 10 nm diameter gold nanosphere, we find that the presence of the nanoplasmonic field enhances the oscillation amplitude by a factor of 3.

In this work, we present a semi-analytical quantum-mechanical model to study attosecond streaking from gold nanpspheres, including the plasmonic near-field-enhancement of streaking field at the surface.

We use Mie theory [1] to calculate the plasmonic field near 10 to 200 nm gold nanospheres, driven by incident NIR or visible light pulses, based on a complex-valued frequency dependent dielectric function that was adjusted to experimental data [2]. Figure 1 shows the total field intensity distribution (incident field + plasmonic response), normalized to the incident field intensity, with a maximum enhancement of about 14.

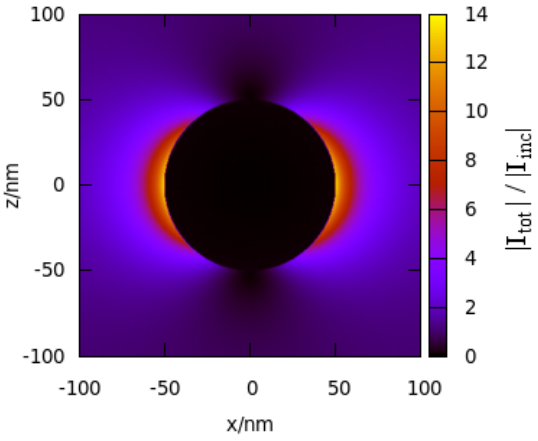

Figure 1. Total field enhancement near a 100 nm diameter gold nanosphere at x-z plane, driven by a 800 nm plane wave propagating in z-direction and polarized in x-direction. Maximum enhancement is found along polarization direction.

We model the gold conduction band in terms of a spherical square well potential. Based on these results, we performed a quantum-mechanical simulation of attosecond streaking from gold nanospheres [3]. Figure 2 shows calculated streaking spectra, where Fig. 2(a) includes plasmonically enhanced field, while in Fig. 2(b) only incident pulse is considered. Both are calculated from a single initial state taken at Fermi level of the gold conduction band. Our results show an enhanced oscillation amplitude, phase shift, and asymmetry of the streaking traces, as a result of the near-field enhancement.

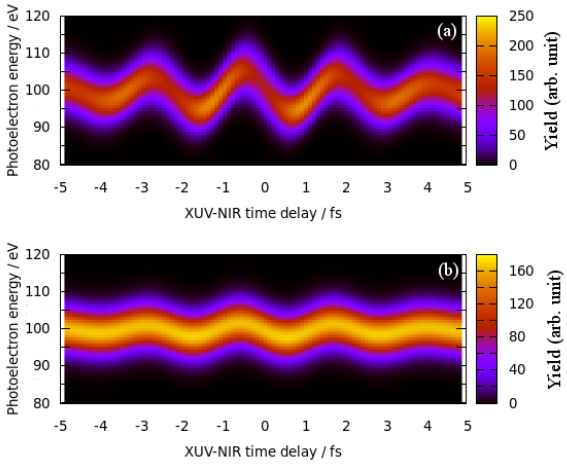

Figure 2. Calculated streaking spectra from a single initial state of a spherical square well potential (at the Fermi level with zero angular momentum) representing a 10 nm diameter gold nanosphere. (a) With plasmonically enhanced near field and (b) without near field enhancement.

References

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