Plasmon coupling on silver cuboids revealed by fast electrons

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Plasmonic nanostructures allow the concentration of light to nanoscale volumes. They are therefore interesting systems for fundamental research and application oriented studies in optics, photovoltaics and sensor technology. Surface plasmons, i. e., resonant collective electron oscillations play an important role in this quest.

Electron energy loss spectroscopy (EELS) in combination with scanning transmission electron microscopy (STEM) has become a powerful technique to study surface plasmons on metal nanoparticles and is used in this work to resolve the corresponding electromagnetic fields with high spatial resolution. The particle design was realized by electron beam lithography on a 15 nm thin silicon nitride membrane.

While previous work has shown that plasmons on nanometric sized particles can be decomposed into film and edge plasmons [1], here we study a silver nanocuboid to reveal the role of plasmon coupling of those excitations. In addition to experimental results, simulations based on a boundary element approach [2] are presented, which help to understand the rich spectrum of plasmonic eigenmodes in this system and its coupling behaviour. It will be shown that the majority of eigenmodes can be assigned to bonding and antibonding edge modes.

References:
[1] F.P. Schmidt et al, Nature Communications 5 (2014) 3604.
[2] U. Hohenester and A. Truegler, Comp. Phys. Commun. 183 (2012), 370.
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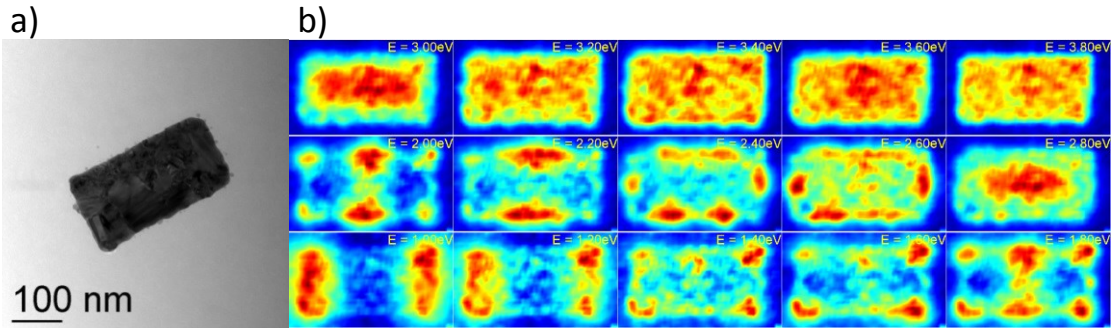

Figure 1. a) Lithographed silver cuboids: TEM image of a 30 nm thick silver cuboid on a 15 nm thin Si3N4 membrane. **b)** Electron energy loss maps acquired on the particle shown in a) at energies ranging from 1 eV (bottom, left) to 3.8 eV (top, right) with an energy-width of 150 meV.