Universal scaling of surface plasmon modes

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Dimensionality has a significant impact on the optical properties of solid-state nanostructures. While semiconductor properties are governed by excitonic effects, the optical response of metal nanostructures is dominated by surface plasmons, that are collective electron oscillations on the metal's surface. In this study we compare surface plasmons on silver nanostructures and extended metal systems and show that the plasmon dispersion in metallic structures of different dimensionality are related by simple scaling rules [1]. We thereby introduce a general and intuitive ordering scheme for plasmonic excitations with edge and surface modes as the elementary building blocks [2].

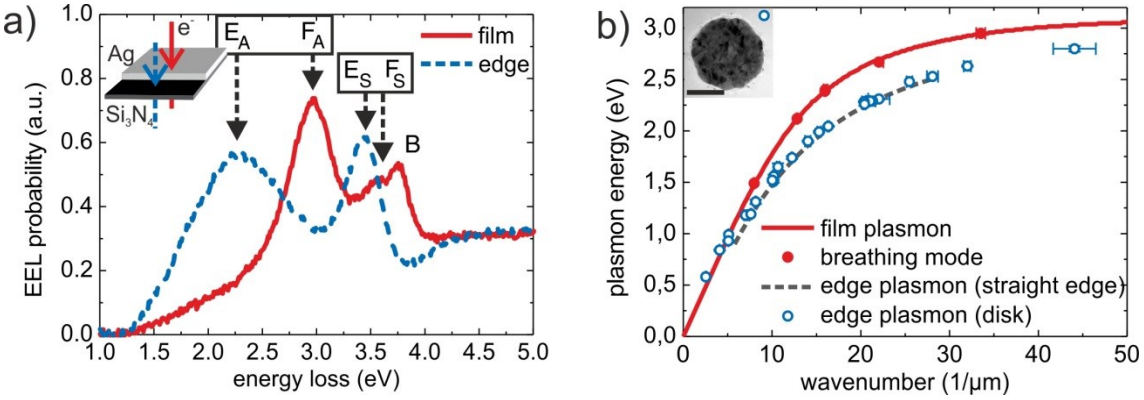

Figure 1. a) Extended silver film: EEL spectra taken on a 30 nm thick silver film on a 15 nm thin Si3N4 membrane (solid line) and outside the silver film, 15 nm beside the edge (dashed line). **b)** Surface plasmon dispersion of an extended Ag/Si3N4 system (solid line) and of disk breathing modes (filled circles) are compared to edge mode dispersion of disks (unfilled circles) and straight edges (dashed line). The scale bar is 100 nm.

References:

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