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Directional coupling of plasmonic disk modes to an edge waveguide

Harald Ditlbacher[1], Franz Schmidt[1, 2], Ulrich Hohenester[1] and Joachim R. Krenn[1]

[1]Institute of Physics, University of Graz, 8010 Graz, Austria,
[2]Institute for Electron Microscopy and Nanoanalysis (FELMI), Graz University of Technology, 8010 Graz, Austria
E-mail: harald.ditlbacher@uni-graz.at

The plasmonic modes of a flat nanodisk can be described in terms of film and edge plasmon modes confined by the geometry of the disk [1,2]. The periodic boundary conditions along the disk circumference act as a ring resonator for edge plasmons [2].

In this work we demonstrate that edge plasmons on a nanodisk can efficiently couple to edge plasmons of a nearby metal film. Figure 1 shows the transmission electron micrograph of a silver nanodisk which is separated 60 nm from the edge of a silver film. On this disk, edge modes like dipole, quadrupole, or hexapole can be excited selectively by focused circularly polarized light. The chirality of the light field determines whether the disk mode is excited clockwise or counter-clockwise, as indicated by the red and blue arrows, and the direction of mode revolution determines the propagation direction of the coupled edge mode on the straight film edge (indicated by arrows).

The plasmon fields are detected by fluorescing molecules close to the silver surface and imaged in a microscope setup. Additionally electron energy loss spectroscopy (EELS) in a scanning transmission electron microscope is employed to extend the energy range to the whole visible spectrum.

Our results clearly show that the propagation direction of plasmonic edge modes can be controlled by the chirality of the light field used for disk excitation.

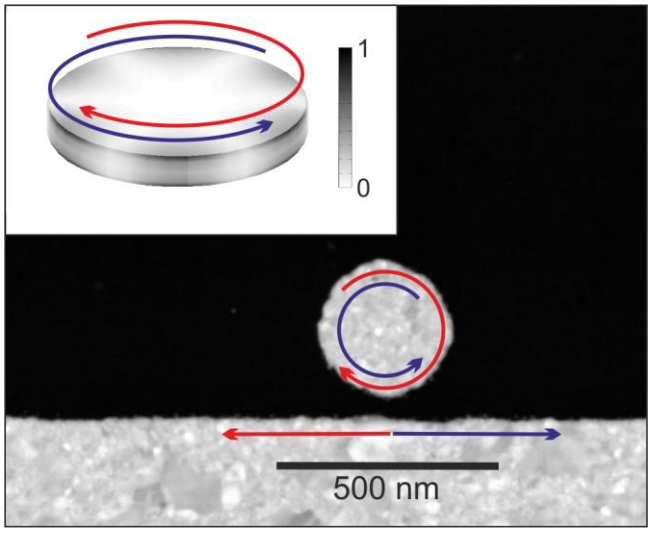

Figure 1. Transmission electron micrograph of a silver nano disk close to the edge of a silver film. The inset shows the normalized calculated density of surface charges of the plasmonic hexapole.

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References

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