ThM07 - **Babinet's principle for disc-shaped plasmonic antennas**

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Babinet's principle relates the optical response of apertures in thin films and their complementary analogues – solid barriers or particles. Originating in the wave theory of light and analysis of diffraction, it has recently entered the field of plasmonics. According to Babinet's principle, localized surface plasmons in complementary particles and apertures have identical resonance energies and their near field are closely linked: The electric field distribution of a specific in-plane polarization for an aperture corresponds to the magnetic field distribution of perpendicular polarization for a particle [1]. On the other hand, substantial differences can be related to different fabrication processes and experimental techniques involved in the characterization of real structures. Abstracts / Oral Presentations 191 Here we present an experimental study of Babinet's principle of complementarity in plasmonics. We have studied a set of elementary plasmonic antennas - gold discs and disc-shaped apertures in a gold layer - to investigate electromagnetic properties of complementary structures and describe similarities and differences. Localised surface plasmon resonances supported by the antennas were characterized by electron energy loss spectroscopy and cathodoluminescence. While the qualitative validity of Babinet's principle has been confirmed, quantitative differences have been found related to the energy and quality factor of the resonances and the magnitude of related near fields. As it is found by comparing the experimental data with numerical simulations, differences originate both from the limited theoretical validity of the Babinet's principle and from different operational conditions. In particular, apertures were found to exhibit stronger plasmonic response than solid antennas, which makes them a remarkable alternative of the usual plasmonic-antennas design. We also examine the possibility of magnetic near field imaging based on the Babinet's principle.

[1] M. Hentschel, T. Weiss, S. Bagheri and H. Giessen, Nano Lett. 13, 4428–4433 (2013).