Mesoscopic Materials Research Laboratory Seminar

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Room: 2E-303 (Meeting Room of Dept. of Electrical and Electronic Engineering)

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Mechanotunable plasmonic metasurfaces

Light of particular energy can excite collective electron oscillations in metal nanoparticles (localized surface plasmon resonance). These resonances can be tuned by size, shape and material of the individual nanoparticles. Arranging such nanoparticles into well-defined arrays, also termed plasmonic metasurfaces, allows controlled manipulation of light propagation, intensity and phase guided by the individual design.

Following this principle, I am going to present: 1.) the formation of a sharp surface lattice resonance via coherent coupling of gold nanoparticles in 2D periodic lattices. 2.) Giant circular dichroism (differential extinction of left and right circularly polarized light) in a 3D chiral metasurface of cross-stacked gold nanoparticle chains. The strong electric fields localized in the lattice plane (system 1) hold great potential for nanolasing. In contrast, the superchiral fields present in the chiral metasurface (system 2) enable ultrasensitive, enantio-selective detection of chiral molecules, as demonstrated in a proof-of-concept experiment.

Both systems are constructed in a cost-efficient manner from wet-chemically synthesized nanoparticles via template-assisted self-assembly. Employing elastomeric substrates facilitates in-situ, real-time tuning of the pronounced optical effects via mechanically induced, reversible rearrangement of nanoparticles. Consequently, this approach is promising for the fabrication of mechanotunable polarizers and nanolasers as well as strain sensors.

Ref) P. Probst, *et al.*, *Nature Materials*, 20, 1024 (2021)