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Beyond standard fabrication techniques in nano-optics: Tuning second harmonic generation in nanoscale volumes by controlled local symmetry breaking

Plasmonic nanostructures allow to control and enhance light-matter interaction on the nanoscale and are therefore of great interest for spectroscopic and optical sensing applications as well as for efficient electroluminescence from small volumes. In particular, optical antennas with narrow gaps exhibit field hot spots with very large near-field intensity enhancement, which renders them highly attractive also for the enhancement of nonlinear optical processes such as second harmonic generation.

In my talk, I will present an advanced fabrication approach that combines gallium and helium focused ion beam milling of single-crystalline gold microplatelets achieving sub-5 nm precision within a single top-down process. The resulting advanced control over the geometric and thus optical properties of the fabricated antennas is used to systematically break the local mirror symmetry in the antenna gap. The second harmonic radiation of these locally asymmetric antennas is shown to strongly depend on the degree of asymmetry allowing to tune the second harmonic yield. The ultra-high precision of the fabrication approach further permits to quantitatively model the second harmonic process and to determine fundamental nonlinear constants of the structure.