POPULAR SCIENTIFIC ABSTRACT

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Linear and Nonlinear Plasmonics with Monocrystalline Gold Flakes

Metallic nanostructures offer unique possibilities to concentrate light at nanometer and even sub-nanometer scale. This is possible because light can excite collective oscillations of free electrons in metals, giving rise to electromagnetic surface waves, known as surface plasmons polaritons. Utilitarian design of plasmonic nanostructures allows to controllably enhance linear and nonlinear light-matter interaction, which is a desired feature in many areas of technology and research, for example in telecommunications, biomedical sensing, flat optical components and many others. Furthermore, modern plasmonics strives to meet the demands of next-generation quantum technologies. However, the success of these advancements largely depends on the reduction of electromagnetic losses in metallic materials, which constitutes the most ubiquitous problem of current devices.

This PhD thesis presents experimental investigations of the plasmonic properties of (quasi-)monocrystalline gold flakes, which emerged recently as a material platform to supersede the traditionally used polycrystalline gold films. First, the optical response in the linear regime, including nonlocal effects, is discussed in detail, and prospective functionalities for advanced plasmonic devices are experimentally demonstrated. Second, the nonlinear response arising from the interaction of crystalline gold with intense ultrashort light pulses is considered, with experiments revealing that monocrystalline flakes produce a strong anisotropic second-order nonlinear response which is markedly absent in polycrystalline films. In addition, two-photon luminescence microscopy is used to study the nonlinear absorption dynamics in gold flakes that are few tens of nanometers in thickness, exploiting their strong intrinsic third-order susceptibility. Preliminary results indicate that ultrafast two-photon absorption dynamics is significantly altered when the gold thickness approaches mesoscopic dimensions (i.e. when they become thinner than 30 nm).

The results presented in this thesis confirm that monocrystalline gold flakes are among the best candidates for the experimental exploration of nonlocal and nonlinear plasmonic phenomena and can be used for substantial improvement of existing plasmonic devices.

Zoom link

Meeting URL: https://syddanskuni.zoom.us/j/64508435304?pwd=bmR0ZGxwbkpRMks1djNCVUF2TEtsdz09
Meeting ID: 645 0843 5304
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