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Hybrid Assemblies Based on Plasmonic Semiconductors

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Research on nanomaterials is becoming more and more popular each day as they find applications in many fields ranging from catalysis to drug delivery. Nanomaterials based on noble metals are of special interest, due to the fact that they can hold the so-called localized surface plasmon resonances upon interaction with light.1 Plasmonic nanomaterials however, are not limited to noble metal nanoparticles. Semiconductor nanoparticles with p-type doping also show similar plasmonic properties and a major advantage of plasmonic semiconductors over their metal counterparts is the possibility they offer to tune their optical and electronic properties by varying the free carrier concentration.2 In the last few years our group has investigated the plasmonic properties of vacancy-doped copper chalcogenide nanocrystals; showing that their localized surface plasmons in the near infrared (NIR) spectral region originate from the collective oscillation of holes, and that it is possible to turn "on"and "off"their plasmonic properties by chemical means.3 Combining plasmonic semiconductors with other functional nanomaterials can serve as a starting point to investigate so far unexplored phenomena at the nanoscale.

The goal of this work is to develop a hybrid nanomaterial made of plasmonic copper chalcogenide supraparticles (namely Cu2-xSe) enclosing magnetic cores to merge the plasmonic and magnetic properties of the individual components into a nanosized single system. Magnetic nanoparticles are widely employed for catalyst recovery and water purification due to their versatility as they enable one to control the system externally and are easily separable. By combining the intrinsic properties of magnetic nanoparticles with the optoelectronic properties of Cu2-xSe it will be possible to investigate the interaction between a plasmonic semiconductor and a magnetic nanoparticle core, with the aided advantage provided by the possibility of "switching on"and "off"the plasmonic properties of the semiconductor building-block.

References:

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