

Reshaping and Alloying of Noble Metals Nanocrystals Mediated by Ultrafast Pulsed Laser Irradiation

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The potential of noble metals such as gold and silver for technology applications is primarily related to their capability to adopt different shapes and dimensions, which eventually determine their appealing optical signatures. In this sense, the last two decades have witnessed tremendous progress in the synthesis of noble metal nanoparticles, primarily ascribed to the advancement of colloidal methods [1]. Recently, a combination of colloidal synthesis routes with ultrafast pulsed laser irradiation has emerged as a unique tool to control various properties of noble metal nanoparticles, including shape, dimensions, and composition [2]. This methodology relies on the excitation of conduction electrons of the metal with ultrashort laser pulses, which leads to lattice temperature increments that eventually result in melting, evaporation, and even fragmentation of the irradiated nanoparticles.

This talk will be dedicated to discussing how, through the use of femtosecond laser pulses, we can afford the fabrication of colloidal gold nanorods featuring ultranarrow optical bands near the theoretical limit [3]. I will show the importance of pulse fluence and irradiation wavelength in determining the magnitude of the heating and cooling processes to explain the improvement of the nanorod optical properties via a gentle laser-induced reshaping phenomenon. In this context, the formation of partially or completely alloyed gold-silver nanostructures and hollow nanocrystals will be presented, aiming to reveal the potential of ultrafast laser irradiation as an advanced tool for fabricating unique noble metal nanomaterials [4,5]

References:

- [1]. Y. Xia *et al.* Seed-Mediated Growth of Colloidal Metal Nanocrystals *Angew. Chem. Int. Ed.* **2017**, *56*, 60.
- [2]. G. González-Rubio *et al.* Reshaping, Fragmentation, and Assembly of Gold Nanoparticles Assisted by Pulse Lasers. *Acc. Chem. Res.* **2016**, *49*, 678–686.
- [3]. G. González-Rubio *et al.* Femtosecond laser reshaping yields gold nanorods with ultranarrow surface plasmon resonances. *Science*. **2017**, *358*, 640–644.
- [4]. G. González-Rubio *et al.* Controlled Alloying of Au@Ag Core-Shell Nanorods Induced by Femtosecond Laser Irradiation. *Adv. Opt. Mater.* **2021**, *9*, 2002134.
- [5]. G. González-Rubio *et al.* Formation of Hollow Gold Nanocrystals by Nanosecond Laser Irradiation. *J. Phys. Chem. Lett.* **2020**, *11*, 670–677