IRRADIATION OF GOLD NANOPARTICLES WITH ULTRA-FAST LASER PULSES

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Abstract Gold nanorods (NRs), pseudo-one-dimensional rod-shaped nanoparticles (NPs), have become one of the burgeoning materials in the recent years due to their anisotropic shape and adjustable plasmonic properties [1]. Under light irradiation, noble metal nanoparticles, particularly those characterized by localized surface plasmon resonance, commonly known as plasmonic nanoparticles, generate a strong electromagnetic field, excited hot carriers, and photothermal heating. The irradiation of rod–sphere assemblies with ultrashort laser pulses, producing structures that are very difficult to obtain by other methods [2]. The optical response of these assemblies displays several peaks arising from the interaction of the plasmon modes of the individual particles, offering thus great flexibility to control the energy deposited on the individual particles. Judicious selection of the wavelength and fluence of the laser pulses allows fine control over the changes produced: the particles can be melt and/or the organic bonds cleaved. In this way, it is possible to generate structures "à la carte" with a degree of control unmatched by other synthetic protocols. The method is exemplified with gold nanoparticles, but it can be easily implemented on particles composed of different metals, widening considerably the range of possibilities. The final structures are excellent candidates for surface-enhanced spectroscopies as they have a very intense electric field located outside the structure, not in the gaps.

References

[1] Pablo Díaz-Núñez,† Guillermo González-Rubio,‡,§ Alejandro Prada,†,⊥ Jesús González Izquierdo,‖ Antonio Rivera,† Luis Bañares,‡,‖ Andrés Guerrero-Martínez,‡ and Ovidio Peña-Rodríguez*,† J. Phys. Chem. C 2018, 122, 19816−19822
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Figures

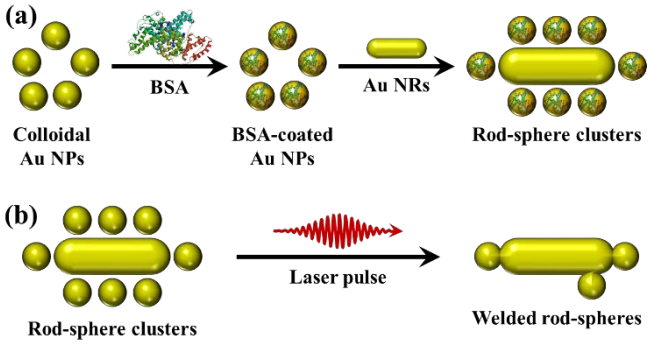

Figure 1: **Schematic representation of (a) synthesis of Au rod– sphere nanoclusters and (b) welding of those nanoclusters by irradiation with fs laser pulses.**