Femtosecond Laser-Controlled Tip-to-Tip Assembly and Welding of Gold Nanorods

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The unique collective optical properties that arise when plasmonic gold nanocrystals are in close proximity depend strongly on the rational design of the self-assembly procces.[1,2,3] In this context, one of the most efficient methologies to achieve nanoparticles assembly relies on the use of dithiolated molecular linkers.[3] In direct analogy to molecular polymerization, the chain growth process through the formation of initial short oligomers which then elongate producing a broad population of aggregates. However, this mechanism renders highly polydisperse samples which make are hard to use for applications in nanoplasmonics. Based on the irradiation with low fluence near-infrared (NIR) femtosecond laser pulses, we propose a novel route to obtain selected plasmonic oligomers in high yields.[4] Herein, we synthesize gold nanorods of which octanedithiol mediated tip-to-tip assembly leads to formation of trimers in optical resonance with a 800 nm Ti:sapphire femtosecond laser. Thereupon, irradiation with fs pulses induces the formation of hot spots that favor the photothermal decomposition of the interparticle molecular linkers. Consequently, rupture of the trimers takes places meanwhile dimers, which are not in resonance with the laser, remain intact. Furthermore, when the laser energy exceeds certain threshold, melting and welding of gold nanorod through the tips occur, offering a new pathway to forge plasmonic species with optical response at the NIR.

References

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