Templated Assembly of Nanoplasmonic Supercrystal Arrays

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The integration of nanoparticle superstructures into daily life applications faces major challenges including the simplification of the self-assembly process, reduced cost and scalability. It is however often difficult to improve on one aspect without losing on another. Stamping and templated assembly have been used to create single- and multi-particle patterns, but these are typically limited to a small number of particles. We have recently developed a bench-top method that allows patterning a macroscopic substrate with gold nanoparticle supercrystals in a one-step process. The method allows parallelization and patterned substrates can be made with high throughput. The self-assembly of a variety of building blocks into crystalline superstructures takes place upon solvent evaporation and their precise placement over millimeter scale areas is induced by confinement of the colloidal suspension in micron sized cavities. We mainly focus on gold nanorods and demonstrate their hierarchical organization up to the device scale. The height of the formed nanorod supercrystals can be tuned by simply varying nanorod concentration, so that the topography of the substrate and the resulting optical properties can be readily modulated. The crystalline order of the nanorods results in homogeneous and high electric field enhancements over the assemblies, which is demonstrated by surface enhanced Raman scattering spectroscopy.

Reference

[1] C. Hamon, S. Novikov, L. Scarabelli, L. Basabe-Desmonts, L.M. Liz-Marzán, ACS Nano 2014, 8, 10694.