Plasmonic mode engineering with templated self-assembled nanoclusters

Jonathan A. Fan\textsuperscript{1}, Kui Bao\textsuperscript{2}, Li Sun\textsuperscript{1}, Jiming Bao\textsuperscript{3}, Vinothan N. Manoharan\textsuperscript{1,4}, Peter Nordlander\textsuperscript{2}, and Federico Capasso\textsuperscript{1}

1. School of Engineering and Applied Sciences, Harvard University
2. Department of Physics, Rice University
3. Department of Electrical and Computer Engineering, University of Houston
4. Department of Physics, Harvard University

Plasmonic nanoparticle assemblies are a materials platform in which optical modes, resonant wavelengths, and near-field intensities can be specified by the number and position of nanoparticles in a cluster. A current challenge is to achieve clusters with higher yields and new types of shapes. I show that a broad range of plasmonic nanoshell nanoclusters can be assembled onto a lithographically-defined elastomeric substrate with relatively high yields using templated assembly. Three types of clusters are assembled and measured: Fano-resonant heptamers, linear chains, and rings of nanoparticles. The yield of heptamer clusters is measured to be over thirty percent. The assembly of plasmonic nanoclusters on an elastomer paves the way for new classes of plasmonic nanocircuits and colloidal metamaterials that can be transfer-printed onto various substrate mediums.

![Schematic of the template-assisted self-assembly process](image)

**Self-assembled clusters.** (a) Schematic of the template-assisted self-assembly process, in which nanoshells are blank into substrate voids via capillary forces. (b-d) Experimental spectra of heptamer clusters (b), symmetric quadrumer clusters (c), and linear chains (d) of nanoshells. The scale bar represents 200nm.