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Versatile design of metal nanoarchitectures for photonic applications

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Abstract

Optical properties resulting from dipole moments in nanoparticles (NPs) assembled in a periodic or cluster architecture enable exploration of metamaterial, near field enhancement, and narrow band resonances. It is a long-standing challenge to fabricate architectures using high throughput methods with tunable properties at optical frequencies. Standard lithographic techniques to produce metal nanoarchitectures are typically not easily translated into large-area production. In contrast, techniques involving directed self-organization can be inexpensive and scalable. Here synergistic research on (i) design of optical structures, (ii) fabrication using self-organization processes on polymer surfaces that serve as both low-cost substrates and allow for selective chemical functionalization for NP cluster assembly and thermally responsive optical properties, and (iii) correlations between optical properties and NP arrangement will be presented. Surface enhanced Raman scattering measurements on chemically assembled NP systems are found to achieve reproducible, high signal enhancements from point to point across the sample surface.