Nanostructured photonic metamaterials reconfigurable with light, nanomechanical and electromagnetic forces

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Active and dynamic manipulation of metamaterial optical properties is the foundation for metamaterial devices. Such metadevices will translate metamaterials from fundamental scientific research to practical applications including optical switches, optical modulators, tunable spectral filters, and programmable transformation optics devices. Here we develop reconfigurable photonic metamaterials that offer a flexible platform for fast dynamic control of metamaterial optical properties.

The properties of any metamaterial structure strongly depend on the spatial arrangement of its building blocks. By constructing metamaterials on elastically deformable scaffolds we can dynamically control the nanoscale spacing among constituent elements across the entire metamaterial array. Based on this approach, we use electrostatic, Lorentz and near field optical forces to drive high-contrast, high-speed active tuning, modulation and switching of photonic metamaterial properties and to deliver exceptionally large opto-mechanical nonlinearities.