Reconfiguring Photonic Metamaterials

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Dynamic control over metamaterial optical properties is key for the use of metamaterials as active elements ranging from modulators and switches to tunable filters and programmable transformation optics devices. Here we exploit that the properties of virtually any metamaterial structure strongly depend on the spatial arrangement of its components. By manufacturing plasmonic metamaterials on a grid of elastic dielectric bridges of nanoscale thickness, we are able to dynamically rearrange sub-micron sized plasmonic building blocks across the entire metamaterial array (see figure). We demonstrate that this approach provides a flexible platform for continuous tuning, fast modulation and high-contrast switching of photonic metamaterials via external stimuli such as electric voltages, optical excitation and magnetic fields.

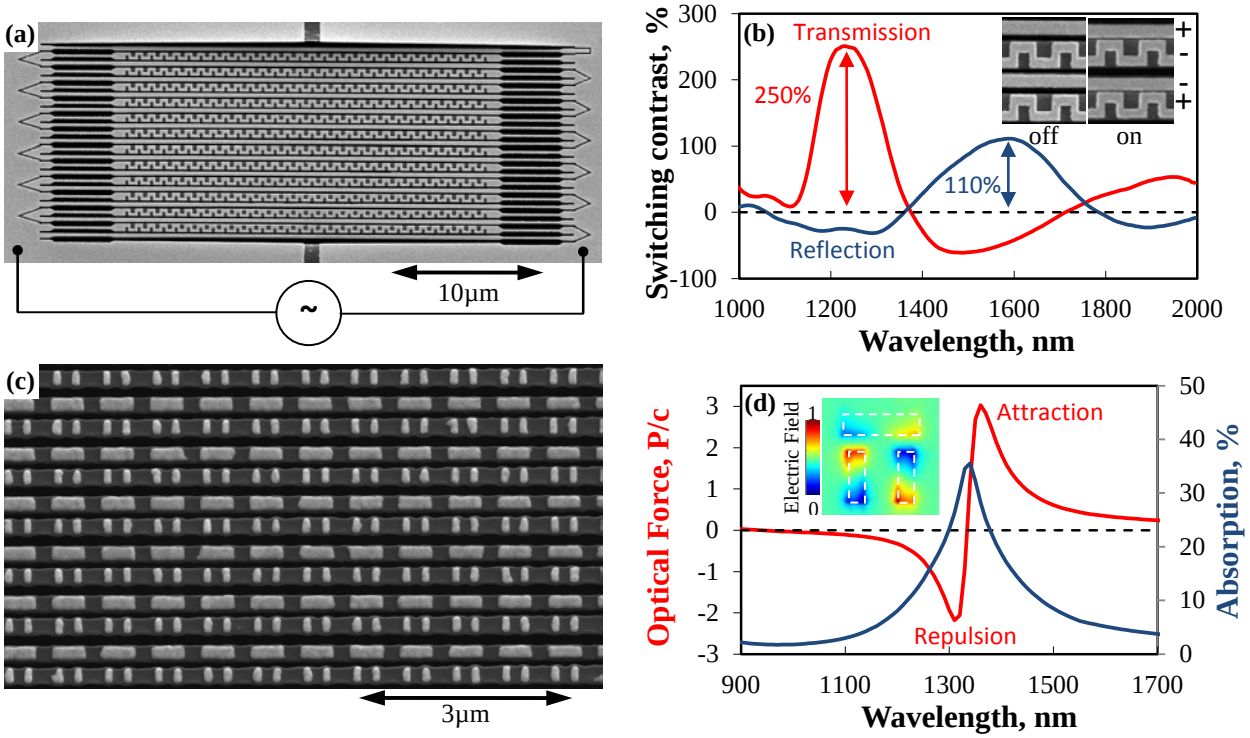

Figure: (a) Electrostatically reconfigurable metamaterial and (b) measurements of its switching contrast in transmission $\Delta T/T$ and reflection $\Delta R/R$. (c) Optically reconfigurable metamaterial and (d) corresponding simulations of optical forces (in units of light pressure, power/speed of light), absorption and resonant electric field distribution. The incident light is polarized parallel to the bridges in all cases.