Solution-Processed Switchable Metamaterials from Colloidal Nanocrystal Inks

백태종†
중앙대학교 창의 ICT공과대학 융합공학부
(paiktae@cau.ac.kr†)

We demonstrate thermally switchable VO_2 metamaterials fabricated using solution-processable colloidal nanocrystals (NCs). Vanadium oxide (VO_x) NCs are synthesized through a nonhydrolytic reaction and deposited from stable colloidal dispersions to form NC thin films. Rapid thermal annealing transforms the VO_x NC thin films into monoclinic, nanocrystalline VO_2 thin films that show a sharp, reversible metal–insulator phase transition. We fabricate "smart", differentially doped, multilayered VO_2 films to program the phase and therefore the metal–insulator behavior of constituent vertically structured layers with temperature. With increasing temperature, we tailored the optical response of multilayered films in the near-IR and IR regions from that of a strong light absorber, in a metal–insulator structure, to that of a Drude-like reflector, characteristic of a pure metallic structure. We demonstrate that nanocrystal-based nanoimprinting can be employed to pattern multilayered subwavelength nanostructures, such as three-dimensional VO_2 nanopillar arrays, that exhibit plasmonic dipolar responses tunable with a temperature change.