Electrically and Optically Tunable Plasmonic Guest-Host Liquid Crystal Colloids with Long-Range Ordered Nanoparticles

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Practical liquid crystal guest-host devices remain elusive for decades despite promising efficient displays and emergent applications such as smart windows. This is mainly because of poor stability, surface precipitation, and limited means for property engineering of dichroic dyes. To overcome these challenges, we develop plasmonic metal nanoparticle analogs of dichroic guest-host liquid crystals. Nematic dispersions of aligned anisotropic metal nanoparticles are enabled through the control of weak boundary conditions for orientation of anisotropic host molecules on nanoparticle surfaces. Control of the ensuing surface interactions leads to long-range ordered colloidal dispersions, allowing for collective optical and electrical switching of rod- and platelet-like nanoparticles. This facile control of mesostructured plasmonic medium’s optical properties in visible and infrared spectral ranges is of interest for many display, electro-optic, and renewable energy applications.

KEYWORDS liquid crystal, gold nanoparticles, plasmonic, guest-host display, self-assembly