

Crystalline Colloidal Self Assembly: A Motif for Creating Smart Materials for Chemical Sensing

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We have developed a novel class of smart optical materials based on soft materials which are responsive to their environment and which can be actuated chemically or photonically. Highly charged, monodisperse colloidal particles will self assemble in water into crystalline colloidal arrays (CCA) which are either body centered or face centered cubic structures. We have developed smart materials from these self assembled structures, which utilize the highly efficient Bragg diffraction of light from the CCA periodicity. We polymerized these CCA into acrylamide hydrogels. These CCA-embedded hydrogels show the rich volume phase transition phenomena characteristic of these soft materials. These materials act as frequency agile optical filters. We have functionalized these hydrogels with dyes and photochromic molecules, as well as with molecular recognition agents which cause the hydrogel to change volume in response to either photons, or the presence of specific analytes (eg Pb^{2+} , glucose etc). The resulting volume changes alter the array spacing, which causes the diffracted light wavelength to shift, or causes the diffraction efficiency to change. We will discuss the synthesis of highly charged, monodisperse colloidal particles, the volume phase transition properties of the hydrogel arrays, and the use of these arrays as chemical sensors.