Fabrication of Colloidal Crystal Film Using Melt-Shear Self-Assembly of Core-Shell Nanoparticles for Mechanochromic Strain Sensing

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Colloidal crystals exhibit a unique structural color which have been used as various photonic applications such as colorimetric sensors, displays, and anti-counterfeiting. Recently, it has been realized by using melt-shear of core-shell nanoparticles, which offers large-area and continuous production of "crack-free" colloidal crystal film. It can be used as a strain sensor due to their mechanochromic behaviors, but further studies about the effect of mehcanical property of material to their mechanochromic behaviors are required. In this study, we fabricated non-closed-packed films showing mechanochromic behavior by using core-shell colloidal nanoparticles. To achieve this, we synthesized core-shell nanoparticles consisted of poly styrene core, poly(metamethyl acrylate) interlayer, and poly(ethyl acrylate) shell by stepwise emulsion polymerization. We fabricated colloidal crystal films by melt-shear process which reflect light in the visible light region and it showed the mechanochromic property. Finally, we added additional polymers to the colloidal crystal films to control the mechanical property thereby controlling the mechanochromic response by strain.