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Strain-Tunable One Dimensional Photonic Crystals Based on Zirconium Dioxide/Slide-Ring Elastomer Nanocomposites for Mechanochromic Sensing IRENE HOWELL, CHENG LI, NICHOLAS COLELLA, University of Massachusetts-Amherst, KOHZO ITO, University of Tokyo, JAMES WATKINS, University of Massachusetts-Amherst — Here we report on the fabrication and performance of tunable one dimensional photonic crystals (1DPCs) based on zirconium dioxide/Slide-Ring elastomer nanocomposites. 1DPCs, or Bragg mirrors, display a photonic stop band at specified wavelengths based on the design of their alternating high and low refractive index layers. By adjusting the weight percent of nanoparticles in the composite materials, a refractive index contrast of 0.18 can be achieved between filled and unfilled elastomer layers. The novel Slide-Ring matrix material consists of supramolecular polyrotaxane polyols, and maintains elasticity in the composite 1DPCs. Additionally, the high refractive index nanopartilces enable greater refractive index contrast when compared with purely polymer systems. Therefore we are able to demonstrate a 1DPC of just 6 periods, which maintains 40% reflectance over strains up to 42%. Due to their elastic and flexible behavior, these materials can function as colorimetric strain sensors. The applied strain results in a visible color shift from red to blue, demonstrating a tensile mechanochromic ($\Delta\lambda/\Delta\varepsilon$max) sensitivity as high as 6.05 nm/%.

Irene Howell
University of Massachusetts-Amherst

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