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Tunable Photonic Bandgap Composites Based on Thermo- and pH-Responsive poly-(N,N-dimethylaminoethyl methacrylate) Hydrogels

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Abstract — A tunable polymeric photonic bandgap composite (TPBC) was created by encapsulating ordered, monodispersed polystyrene spheres within a hydrogel matrix based on poly(N,N-dimethylaminoethyl methacrylate). This polymer swells and contracts with changes in the temperature and pH of its surrounding solution. The volume phase transition property inherent to this poly(DMAEMA) hydrogel was used to reversibly shrink and swell the hydrogel, which causes a variation in the lattice constant and results in a mechanism to tune the stopband. A rejection band was reversibly tuned within the temperature range between 35 and 65°C and solution pH between 2 and 12. A 20 nm shift was observed for each 10°C change in temperature. The volume phase transitions of this poly(DMAEMA) hydrogel were characterized by differential scanning calorimetry (DSC), equilibrium swelling degree measurements and thermo-mechanical analysis (TMA).