Silica-based photonic crystals embedded in a chitosan-TEOS matrix: preparation, properties and applications

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Abstract:

Photonic crystals are materials constructed of nanoscale colloidal particles which self-assemble to form an ordered crystal lattice structure. Being on the order of the wavelength of visible light means that various light interactions occur, resulting in the observation of visible colour from the photonic crystal, with the colour observed depending on the diameter of the colloidal particles which form the crystal lattice structure. A key characteristic of a photonic crystal is refractive index (or dielectric constant) contrast[1]. Photonic crystals composed of colloidal SiO_2 particles, as well as other materials are utilized for their interesting optical properties as the regularly repeating crystal lattice interacts with light of different wavelengths depending on the dimensions of the crystal lattice[2]. Successfully introducing colloidal particles into a stimuli-sensitive framework, such as an interpenetrating polymer network (IPN), allows for manipulation of the lattice structure as the crystal lattice would be expected to swell and shrink as the framework reacts to external stimulus. As the crystal lattice swells/ shrinks a shift in the Bragg diffracted wavelength of visible light reacting with the lattice should be observed. IPNs composed of chitosan (Chi) and tetraethylorthosilicate (TEOS) using chitosan sources of varying molecular weight and varying volumes of TEOS were prepared. Analysis of these membranes indicated which type of chitosan gave the best results as a candidate for the formation of a Chi-TEOS-SiO_2 composite and from this an approach for the synthesis of a free-standing Chi-TEOS-SiO_2 composite was investigated.

References:

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