Nanoparticle based One-Dimensional Photonic Crystals

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Herein we present a synthetic route to build 1D films of TiO_2/TiO_2 and SiO_2/TiO_2 nanoparticles that display bright structural color, which arises as a result of the periodic modulation of the refractive index. This is achieved by controlling the degree of porosity of each alternate layer through the particle size distribution of the precursor suspensions, which were cast in the shape of a film by spin coating. This method allows tailoring the lattice parameter of the periodic multilayer, thus tuning the Bragg peak spectral position (i.e., its color) over the entire visible region, as it can be seen in the figure 1. In addition, the SiO_2/TiO_2 multilayer can be doped optically leading to photonic crystals in which the opening of transmission windows due to the creation of defect states in the gap is demonstrated. The potential of this new type of structures as sensing materials is illustrated by analyzing their specific color changes induced by infiltration of solvents of different refractive index. Moreover, photoelectrochemical measurements show that the TiO_2/TiO_2 Bragg mirrors films are conductive and distort the photocurrent response as a result of the interplay between photon and electron transport through them.

Figures: