Electronic supplementary information to:

High Amount Incorporation and Enhanced Nonlinear Optical Property of Sulfide Nanoparticles within Mesoporous Thin Films

Experimental details:

Preparation of MTFs

The silica MTFs were prepared as previously report on the glass substrates.[16] Typically, 7.68 mL of tetraethylorthosiliate (TEOS, 98%, Aldrich) was prehydrolyzed in a solution containing 3.71 g of dilute hydrochloric acid (pH=2, isoelectric point of silica) and 10 mL of tetrahydrofuran (THF) with vigorous stirring at room temperature. Following 120 min of stirring, this prehydrolyzed silica solution was added to a solution containing 1.78 g of poly(ethylene oxide)-poly(propylene oxide)-poly(ethylene oxide) block copolymer ($EO_{20}PO_{70}EO_{20}$, Pluronic P123, BASF) dissolved in 30 mL of THF. The two solutions were mixed and stirred for a further 30 min.

Formation of semiconductor nanoparticles

The loading of Cd^{2+} ions was achieved through the ion-exchange process. The as-synthesized films were refluxed in the 0.1M cadmium acetate methanol solution at 80°C for 24 h. The resultant films were extensively washed with heated methanol and distilled water to remove the excess Cd^{2+} from surface and then dried at 120°C for 12 h to remove the adsorbed water. Finally, these films were treated with 10 vol% H_2S gas in N_2 for 4 h at room temperature to obtain the CdS nanoparticles loaded MTFs.

The ZnS and PbS loaded MTFs were prepared with the same method by use of 0.1M zinc acetate and lead acetate methanol solution as precursors, respectively.

Z-scan measurements

The third-order nonlinear optical properties were measured using a Z-Scan technique. In our experiment we have used a mode-locked Nd:YAG laser operating at 1064 nm with a pulse duration of 40 ps and a repetition of 10 Hz to eliminate accumulative thermal effect. The laser beam was focused to a beam waist of 35 μm using 7 cm focal length lens, and samples were scanned through its focal region. The light intensities transmitted across the samples were measured as a function of the sample position in the Z-direction with respect to the focal plane either through a small aperture (closed-aperture/CA Z-scan) or without an aperture (open-aperture/OA Z-scan), in order to resolve the nonlinear refraction and absorption coefficient. If there exists nonlinear absorption in the sample, the closed transmittance will be affected by the nonlinear refraction and absorption. The pure nonlinear refractive property should always be corrected by the division of the normalized CA curve by the OA curve. Before measuring, CS_2 was used as a standard reference to calibrate the Z-scan system.