Control of Spontaneous Emission of CdSe Nanorods in a Multi-refringent Triangular Lattice Photonic Crystal

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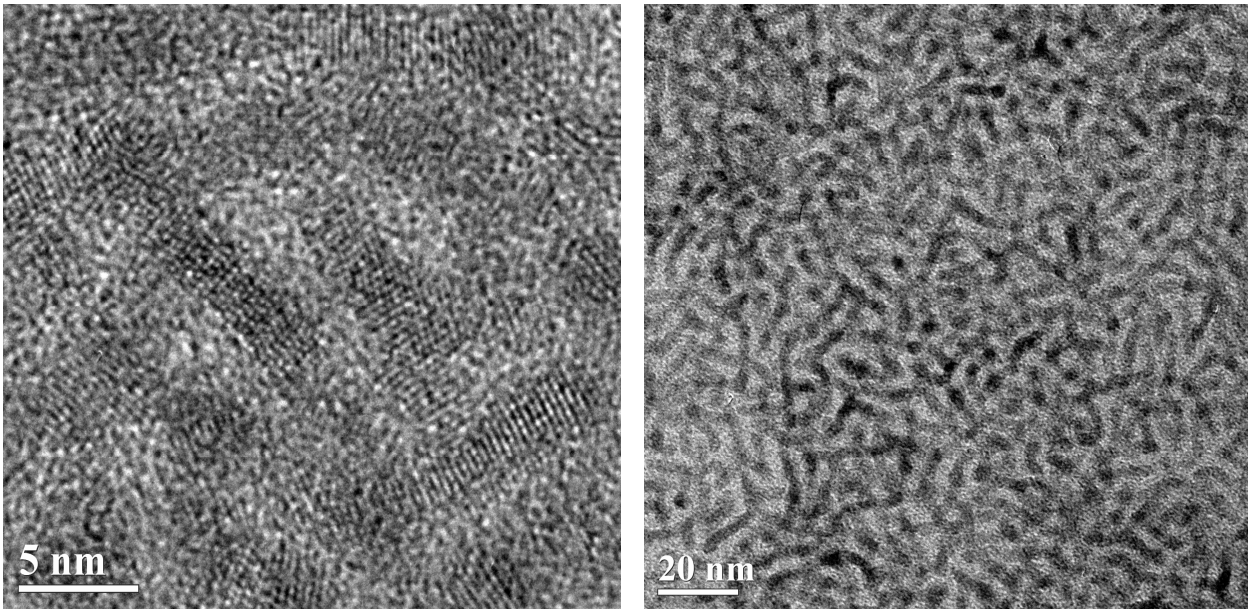
Supporting Information:

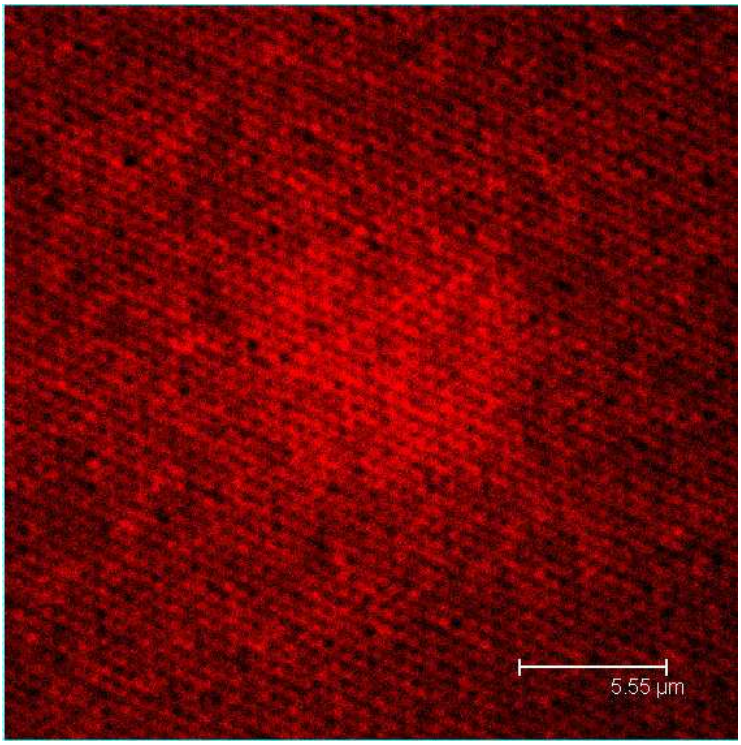
S1: Fabrication of Gold nanoparticles doped photonic crystal: The SU8 polymer was purchased from MicroChem Inc. MIL was used for photo-patterning. Gold nanoparticles in organic phase were prepared by previously reported method.[1] A 10weight% SU8 solution with small amount of photosensitizer was prepared and mixed via ultrasonication with gold nanoparticles (1weight% of SU8) and immediately spin coated onto a pre-cleaned glass substrate. This layer was then polymerized, cured and cooled down to the room temperature. For the top photosensitive layer, SU8 was mixed with a photosensitizer [Rubrene (Sigma-Aldrich)] and a photoacid generator [diaryliodonium hexafluoroantimonate (Polyset PC-2506)]. The 35weight% SU8 solution was spin coated on the composite bottom layer to achieve the thickness of approximately 800nm. After spin coating the top photosensitive layer, the film was baked on a hotplate at 65°C and 95°C successively. After cooling down to room temperature, film was exposed to the laser light. Three beams laser interference lithography was employed to pattern the film. A continuous wave Nd: YVO4 laser (Coherent Verdi V6) operating at 532nm was used for creating the interference pattern. The exposure dose used was between 5-6J/cm^2. After exposure, the film was post-baked on a hotplate at 75°C for 2minutes and allowed to cool down for 5-10minutes, then dipped in Polyglycolmethylethylacetate, followed by final washing carried out in iso-propanol. Finally, reactive ion beam etching (RIE) using a bench-top RIE system (SAMCO Inc.) was used to transfer the pattern to the bottom layer using the top layer as the mask.

S2: Synthesis of CdSe quantum rods: For the synthesis of the QRs in a typical reaction, cadmium carbonate (1mmol) and oleic acid (3mmol) were added to 10ml of trioctylamine in a 250mL three-necked flask. The reaction mixture was slowly heated with vigorous stirring under an argon atmosphere to 280°C. Then 0.5mL of 1M TOP-Se (0.5mmol Selenium in 1.1mmol of trioctylphosphine) was rapidly injected. Samples were withdrawn after 10minutes of injecting the selenium precursor and quenched with toluene. The samples were washed with ethanol to remove the excess surfactants. All the characterizations were done with the CdSe QRs suspended in toluene.

TEM images of CdSe quantum rods:



S3: Confocal image of the quantum rods doped photonic crystals. After the illumination by the laser light CdSe quantum rods were found to be more luminescent owing to photoionization effect.[2] (center was illuminated for a while and then image was taken after zooming out)

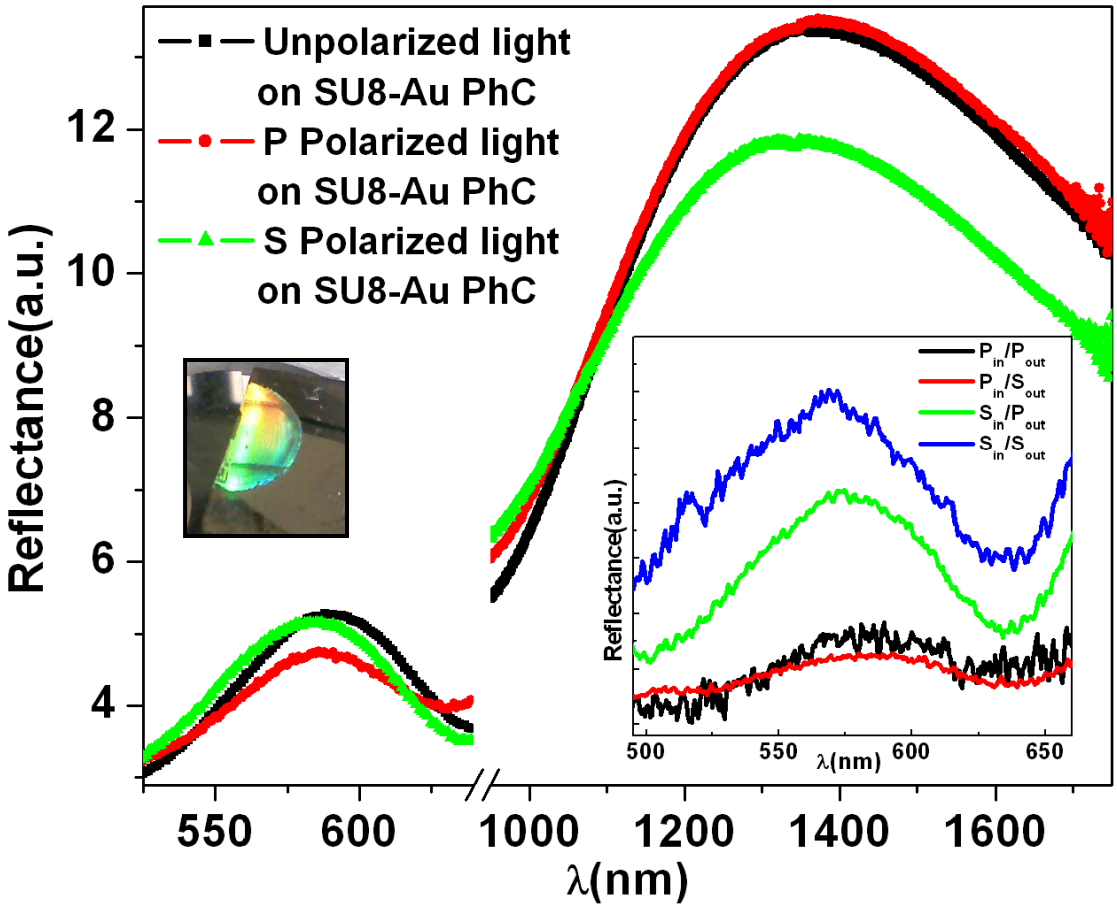


PhC samples were scanned for xyλ series acquisition in confocal microscope. The wavelength series function records a stack of individual images, each of which is detected at a specific wavelength, from a single, optical level. The images are recorded within a wavelength rangeWe have applied averaging method for every individual image, i.e. every xy section or xz-section, is scanned several times at a particular wavelength. For every sampling point, the arithmetical average was calculated from the repeatedly measured intensity values and represented in the result image. The method used here determines a consecutive average. This means every image recorded after the first image is calculated with the results of the previously displayed image and

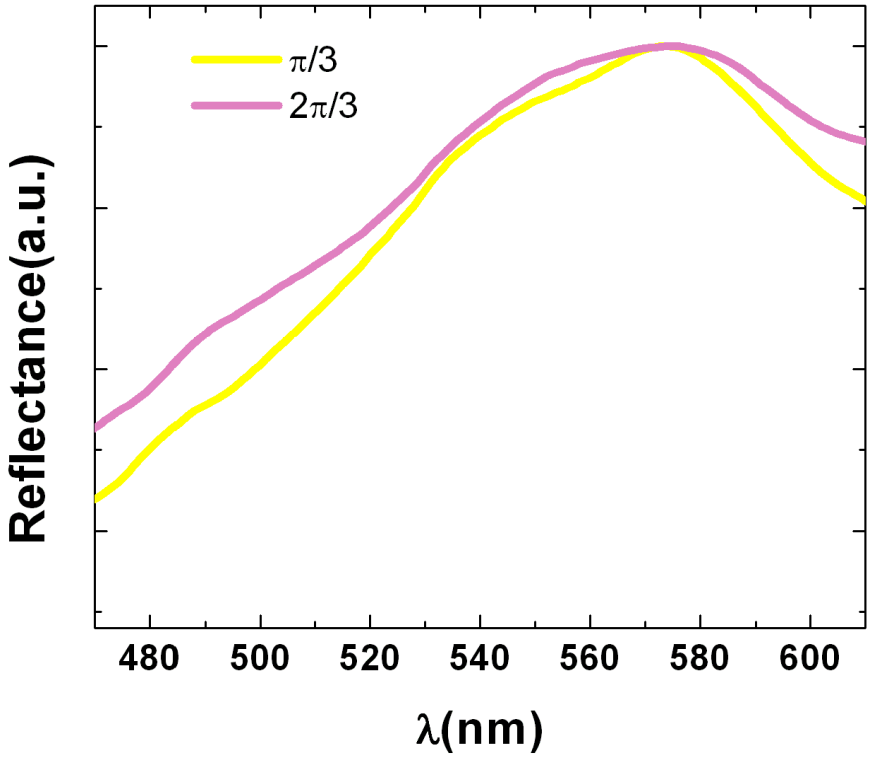
is displayed in the result image (dynamic average). Recording an image using the averaging method is primarily useful for suppressing noise. Thus averaging the scans improve the signal-to-noise ratio by carrying out multiple recordings and determining averages of the image.

S4: Reflectance spectra of SU8-Au PhC obtained with unpolarized, s-polarized (TM) and p-polarized (TE) light. Large Inset shows the polarization mixing by the photonic crystal; small inset shows the digital photograph of fabricated photonic crystal

Pin denotes the P polarized incident light, Pout denotes detection of P polarized light, Sin denotes S polarized incident light and Sout denotes the detection of S polarized light by the detector. Due to mesoscale patterning polarization mixing takes place and S polarized incident light emerges as P polarized light at the output.[3]



S5: Extended reflectance spectra of PhC with π/3 and 2π/3 azimuthal rotation of PhC



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