Supporting information

Simulation of the heterostructure

To achieve a complete study of the heterostructure, we simulated the 0°-transmission spectra (instead of reflection spectra for computing power reasons) of our samples illuminated by a light source of constant intensity over the visible range. Simulations have been performed with the Finite Difference Time Domain (FDTD) method, using the freely available software MEEP developed in MIT.[1] The computed structure is shown on the inset of Figure 9. For the lower and upper opals, the spheres diameter and silica index values, deduced from structural and optical characterizations[2], were set respectively to D=343 nm and n_1=1.32. To reproduce the shape of the defect made of sputtered silica, a monolayer of spheres of same diameter D and of index n_2=1.49 was inserted between the two opals (n_1 is lower than n_2 because of the porosity of the silica spheres synthetized by sol-gel method). The position of these spheres was set so that the distance between their top and the top of the first opal upper layer was equal to the thickness *e* of sputtered silica measured by SEM (Figure 1b). Moreover, to obtain a computed structure as close as possible to real sample, we needed to fill the voids between the two kinds of spheres of the model. For this, we added a rectangular layer of index n_2 and of width *e* between the centers of the two layers.

Figure 9: Top: Schematic of the computed structure. Down: 0°-transmission spectra for an opal without defect (black line) and with defects of different thicknesses (red line: 50 nm, blue line: 112 nm, green line: 150 nm).

On Figure 9, we plotted the 0°-transmitted spectra for a 24 layers-opal without planar defect and for heterostructures with different values of the defect thickness *e*, ranging from 50 nm to 150 nm. One can observe a broad dip of transmission, corresponding to the peak of reflection on experimental reflection spectra, which is the signature of the photonic stopband. Inside this broad dip, a sharper peak (corresponding to an increase of the transmission) appears if a defect layer is embedded between the two opals. It corresponds to the passband created by the disruption of the opal periodicity due to the defect layer. For *e*=112 nm, the defect layer thickness measured on the studied heterostructure, the defect mode is perfectly centered on the stopband as observed on reflection spectra for the real sample. By changing the value of *e*, its spectral position can be tuned inside de stopband.

Construction of the broad light source

We consider a Gaussian source $S(\lambda)$ with a full width at half maximum $\delta\lambda$ centered on λ_c=690 nm which illuminates the sample and reconstruct the corresponding fluorescence intensity as:

$$I_{reconst}(\theta) = \sum_{\lambda} I_{meas}(\lambda,\theta) \times \frac{S(\lambda)}{I_{meas}(\lambda,60°)}$$

In this relationship, $I_{meas}(\lambda,\theta)$ corresponds to the experimental emission diagrams, $I_{meas}(\lambda,60°)$ to the experimental emission diagrams at 60°, far from the stopband of the opal (see Figure 4), and it is used for normalization by the CdTeSe/ZnS nanocrystals intrinsic spectrum.
The reconstructed signal is normalized by the same signal, $I_{reconst}(\theta)$, in the case of the reference sample (opal without planar defect).

1 A. Taflove and S. C. Hagness, *Computational Electrodynamics: The Finite-Difference Time-Domain Method. Third edition*, Norwood MA, Artech House., 2005.

2 A. Avoine, P. N. Hong, H. Frederich, J.-M. Frigerio, L. Coolen, C. Schwob, P. T. Nga, B. Gallas and A. Maître, *Phys. Rev. B*, 2012, **86**, 165432.