Optical surface resonances hide the gap in photonic crystals!

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Photonic crystals possessing a photonic band gap (PBG) are expected to reflect all photons with frequencies that lie within the gap. Recently, high reflectivity (over 90%) peaks associated to a PBG have been reported for colloidal crystals infiltrated with silicon. [1,2] Here we show that this high reflectance is not due to the bulk PBG but rather an optical resonance on the surface that prevents the coupling of photons to the structure for over a wide range which masks the PGB, leading to potentially misleading measurements. We demonstrate that by modifying the surface geometry it is possible to tune the optical response of the resonance and even eliminate it to allow the practical use of the bulk photonic properties. In this contribution, we show both experimental measurements and theoretical simulations [3] (FDTD) that reveal this effect.

[1] Blanco, A. *et al. Nature* **405**, 437 (2000).
[2] Vlasov, Y. A., Bo, X. Z., Sturm, J. C. & Norris, D. J. *Nature* **414**, 289 (2001).
[3] Simulations were performed with the finite-difference time-domain (FDTD) method, using a freely available software package with subpixel smoothing for increased accuracy: A. Farjadpour, *et al. Optics Letters*, **31**, 2972 (2006).