Trapping of photon emission from fluorescence solar collectors and from c-Si absorbers by 3D photonic crystals

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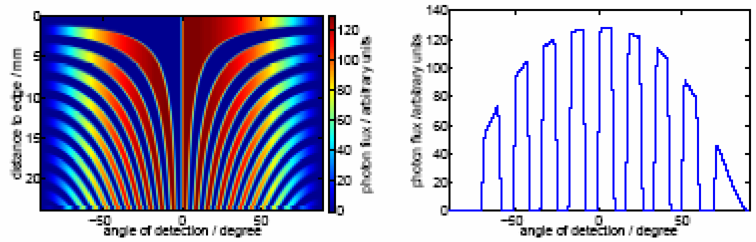
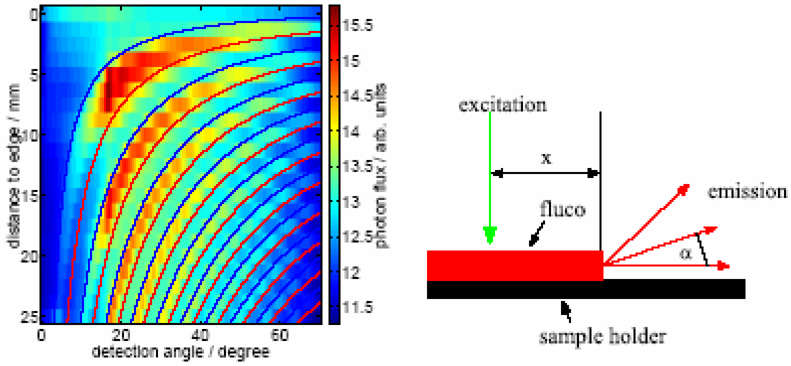
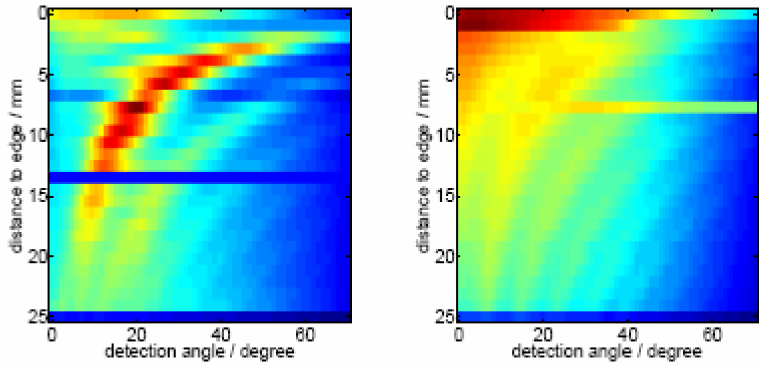
The escape of photons from a fluorescence collector as well as from a c-Si-absorber is substantially reduced by the addition of an appropriate 3D photonic crystal which is geometrically designed in particular for the emission wavelengths of the respective absorber/emitter. We have analyzed angle dependent spectral transmission and reflection of the opal and prove the blocking effect by recording the angle dependence of the spectral fluorescence from the absorber/emitter with and without the opal. By comparison of both respective photon fluxes a substantial reduction of the emission in the appropriate ranges of wavelength and angle is observed.



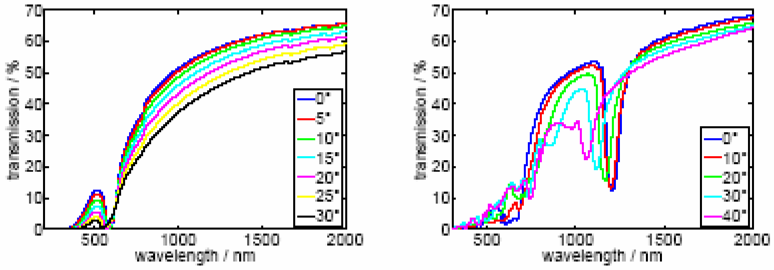
Simulated angular resolved emission of the fluorescence on the edge of a fluco for different excitation positions (distance to the edge x) on the fluco (left) and the angular dependent emission on the edge of the fluco for an excitation at 10 mm



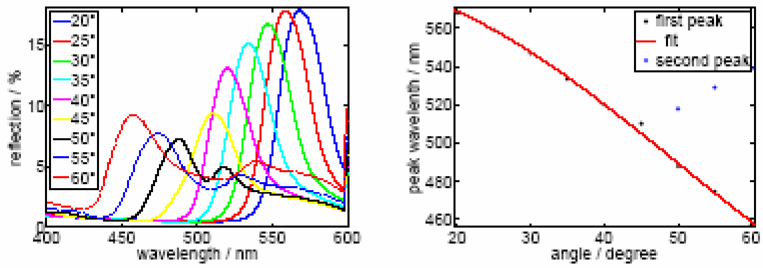
Spectrally integrated angular dependent edge emission of a fluco with Rhodamin 6 G in dependence of the distance between edge and excitation spot in comparison with the simulation results from chapter 2.2.3 (left) and sketch of the experiment (right).



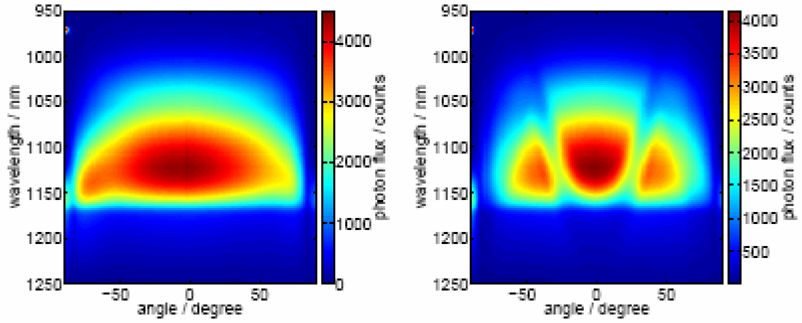
Angular dependent spectrally integrated PL yield for different distances of the excitation from the emission edge for the Lumogen F rot 305 fluco with 0.8 g/l dye concentration (left) and 0.3 g/l (right).



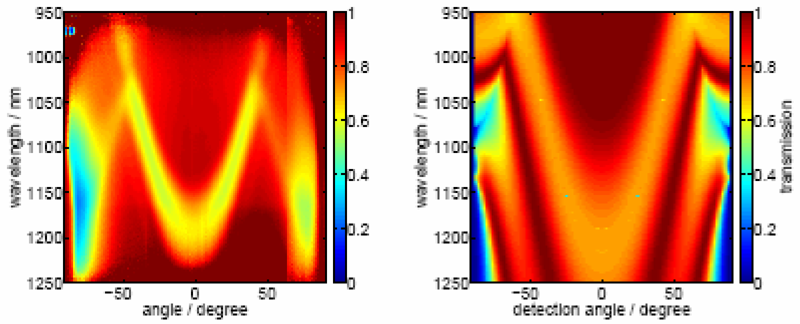
Angular dependent and spectrally resolved transmission through an opal layer on a glass substrate with 580 nm stopgap (left) and 1200 nm stopgap (right).



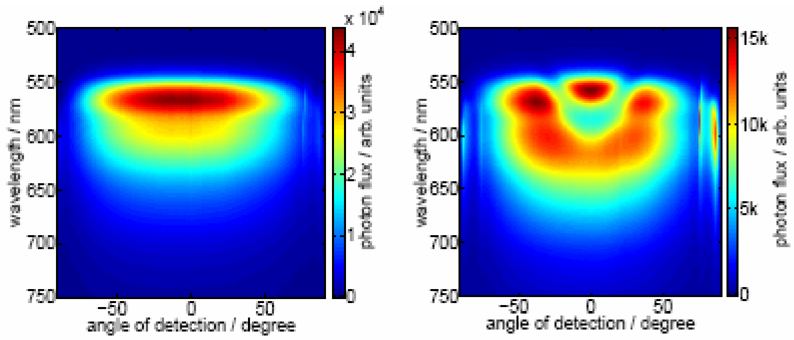
: Angular dependent and spectrally resolved reflection on an opal with 580 nm stopgap on a glass substrate (left) and wavelength of the reflection peaks vs. reflection angle in comparison with the theory (right). The additional reflection peaks for high angles are reflections on an other opal plane.



Angular and spectral resolved top emission from cSi with glass on top (left) and from cSi with glass and 1200 nm stopgap opal on top (right).



Ratio $\chi(\alpha, \lambda)$ between the PL emission with glass substrate and opal and the PL emission with only a glass substrate from the experiment (left) and theory (right).



Angular and spectral dependent top emission from a fluco (Rhodamin 6 G) with glass (left) and from the fluco with glass and 580 nm stopgap opal on top (right).