INOPSE
INVERSE OPALS AS HIGHLY EFFICIENT THERMAL EMITTERS

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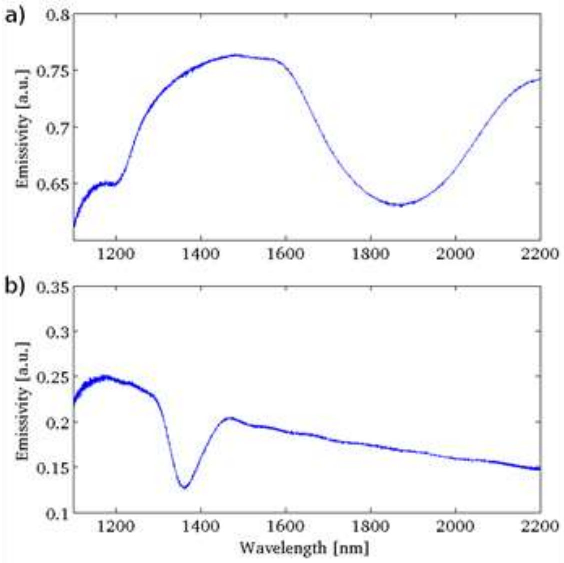
In the field of thermophotovoltaics, the objective is to increase the efficiency of photovoltaic energy conversion by making use of infrared photons produced by thermal sources. The main idea is to design a thermal emitter able to produce only photons that can be converted into electricity by a conventional solar cell. Such emitter, working at 1300-1500K, with the cell at room temperature, will cause in the ideal cause a photovoltaic conversion efficiency of ⍰>80%.

The objective of the project has been the study of the feasibility of self-assembled optical structures to act as high efficient thermal emitters due to their ability for controlling thermal radiation. It has been studied several self-organizing photonic crystals through direct and inverse opals with different materials able to work stable at high temperatures such as silicon and silicon dioxide. The emissivity of the samples has been characterized by NIR spectrometry and the stability of the optical structures at high temperatures has been investigated.

The engineering of photonic gaps where emission is forbidden whose bandwidth and spectral position is controllable and stable at high temperature makes us conclude that photonic self-assembled photonic structures can effectively increase the production of photons in the convertible spectral region. However, further development is needed in order to increase the emission area of the photonic crystal which limits the output power so far.



Emissivity measurements of fabricated inverse opals in a) silicon and b) silicon dioxide. The regions with lowest emissivity near 1900nm (a) and 1350nm (b) corresponds with the photonic stop band of the crystals