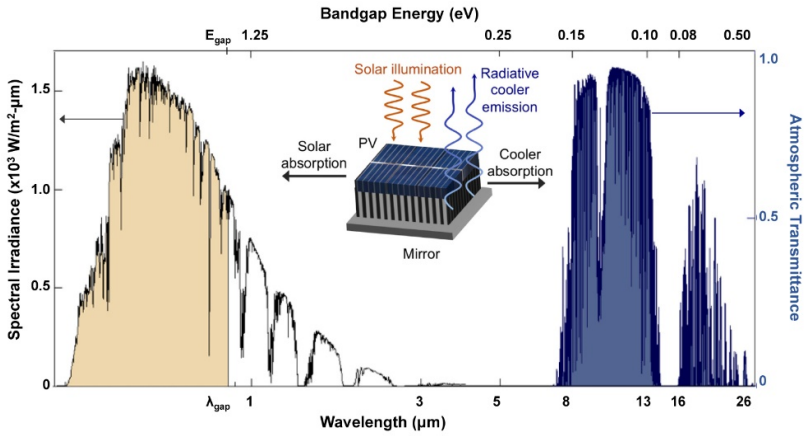
Radiative cooling of solar cells

All bodies on Earth are in continuous exchange of energy with the Sun and the atmosphere, with a net balance of power that depends on the incoming solar and atmospheric radiation, the emitted radiation and non-radiative heat exchanges. Radiative cooling exploits the atmospheric transparency window (8-13 µm) for the passive dissipation of heat from the Earth to outer space [1]. It is a technology with several potential applications from nearly-zero-energy-building to high efficiency photovoltaic systems and huge impact to counter the threat of climate change.

Currently, the development of this technology is in a bottleneck, where the scientific progress relies on either fanciful photonic metamaterials containing rare materials or expensive porous polymer coatings. To overcome this, the recently awarded European project MIRACLE aims at developing a new class of cheap, scalable photonic meta-concretes (PMCs), *i.e.,* nano-engineered cement-based materials, as the "ultimate composites" for radiative cooling of building and solar panels.

The PoliTO team involved in MIRACLE is tackling the interesting challenge to exploit radiative cooling to enhance the efficiency of solar cells, whose value in real operating conditions results from the delicate balance of solar absorption and heat generation [2].



The scope of the M.Sc. thesis is to formulate and develop electro-opto-thermal numerical models aimed at assessing the potential impact of PMCs as passive coolers for photovoltaic cells. The thesis will be carried out in the Microwave and Optoelectronics group (MOG) of the Department of Electronics and Telecommunications (DET). More in detail, the thesis could concern:

- Optical models for stratified meta-concretes dielectric structures
- Simulation of heat transport
- Detailed balance models for the evaluation of the photovoltaic performance

Prerequisites: knowledge of electronic and optoelectronic device fundamentals and scientific coding skills (*e.g.* with MATLAB, Python).

Since a possible follow-up of this MSc thesis is a PhD research program, we are looking for excellent and highly motivated students.

For further info: federica.cappelluti@polito.it, alberto.tibaldi@polito.it
To apply: send a brief motivation letter and a list of exams/grades to federica.cappelluti@polito.it, alberto.tibaldi@polito.it

[1] https://www.nature.com/articles/d41586-019-03911-8
[2] https://www.osapublishing.org/oe/fulltext.cfm?uri=oe-23-19-A1120&id=324445