RADIATIVE COOLING OF SOLAR CELLS: THE POTENTIAL OF CEMENT-BASED SOLUTIONS

Over the years, researchers have developed several cooling technologies for photovoltaic systems, to take advantage of the enhanced power conversion efficiency and extended system lifetime provided by a reduced operating temperature.

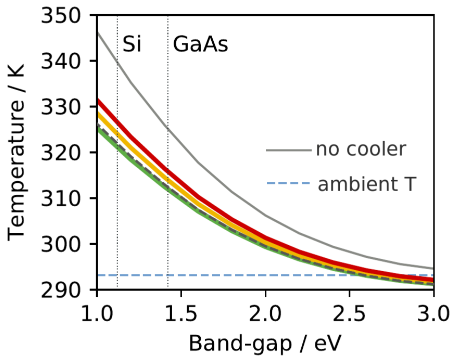
Recently, radiative cooling has been drawing significant attention as a potentially efficient and cost-effective solution for the thermal management of solar cells, able to satisfy energetic, economic and environmental needs without compromising system simplicity.

Yet, the radiative coolers proposed so far rely on metamaterials based on expensive elements, complex fabrication processes, or organic polymers with possible UV-degradation.

Researchers of the MIRACLE consortium are trying to eliminate these weaknesses by efficient radiative coolers based on cheap, scalable and robust cementitious materials.

As published in a recent article (Cagnoni et al., "Cementitious Materials as Promising Radiative Coolers for Solar Cells," *iScience*, DOI: 10.1016/j.isci.2022.105320), they have developed a multi-scale interdisciplinary simulation workflow to show for the first time that humble **ordinary Portland cements (OPC) can be equipped with electromagnetic properties suitable for radiative cooling applications.** Furthermore, they have found that the thermodynamic limit of this solution for the thermal management of **solar cells** is a **temperature reduction of about 20 K**, which could corresponds to outstanding efficiency and lifetime gains (up to 9% and 4×, respectively).

Their work represents a first step toward the realization of a novel class of radiative coolers based on cementitious materials, combining energetic, economical, reliability and scalability requirements, and is expected to trigger many follow-up studies aimed at achieving the practical realization of this attractive concept.



Operating temperature as a function of the solar cell semiconductor band-gap with cement-based radiative coolers and no cooler. The temperature is reduced by about 20 K in silicon-based devices.

For more information, please contact Dr. Matteo Cagnoni (matteo.cagnoni@polito.it) or visit our web page http://miracle-concrete.eu .

This research has been carried out within the MIRACLE project and has received funding from the European Union's Horizon 2020 research and innovate under grant agreement No 964450

MIRACLE Photonic Concrete