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Passive radiative cooling: development and testing of materials for the built environment

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Abstract

The environmental degradation has led to a quest for green and sustainable ways of living. In the built environment, the idea of cooling without energy input is very tempting and has been going around for years, while cool materials keep being more and more effective. Here we analyze two state -of -the - art passive radiative cooling coatings. Radiative cooling materials emit radiation that goes directly to outer space through the atmospheric window while the percentage of radiation that they absorb is as low as possible. The atmospheric window is the window of 8 -13 μm, where the infrared radiation passes immediately to outer space without any significant absorption by the Earth's atmosphere. Thus, it manages to acquire sub -ambient surface temperature which can contribute to improving the thermal comfort conditions in the buildings, the energy conservation, the mitigation of the urban heat island effect while it can also be used for low -grade heat dissipation from power stations

Based on the most recent research papers, we fabricate two radiative materials and we study their performances.

The first material is a porous polymer coating based on the research paper "Hierarchically porous polymer coatings for highly efficient passive daytime radiative cooling" by J. Mandal et al. Using a simple, scalable and cheap phase inversion-based process, we construct a passive radiative coating and then try to merge it with different dyes.

The second material is a diffuse surface material for daytime radiative cooling based on the research paper "Preliminary experimental study of a specular and a diffuse surface for daytime radiative cooling" by Ao, X. et al. We first make the $NaZnPO_4$ powder and out of the powder we chemically prepare the surface.

In order to measure their performance, we test their reflective properties by a UV-Vis-NIR spectrophotometer. We also measure the porous polymer coating using a quantum cascade laser QCL. Finally, we test their performances by placing them on a rooftop and comparing their thermal qualities using a thermal camera.

Keywords: materials, environment, passive radiative, porous polymer