Switchable boron nitride-based colloidal device for passive daytime radiative cooling

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As global warming intensifies, managing heat exchanges in and out of buildings has become crucial to adapt, and limit our greenhouse gas emissions. Today, cooling and heating of buildings together account for about half of the global energy consumption and energy-related CO2 emissions.
In the context of buildings energy efficiency improvement, intelligent technologies based on innovative materials are urgently needed. Indeed, such materials, placed on buildings or roofs, can dissipate excess heat into space through mid-infrared (MIR) thermal radiation via a physical effect called radiative cooling. These radiations, whose wavelength matches the atmospheric transparency window (ATW), are emitted without any energy consumption [1] . During the day, this phenomenon can cool objects below ambient temperature; it is called passive daytime radiative cooling (PDRC).
We aim to develop an energy-saving PDRC device able to switch between a radiative cooling state and an absorptive heating state. For this purpose, the radiative cooler needs to highly reflect solar radiation and to emit in the ATW. To achieve high solar reflectance, we identified hexagonal boron nitride (h-BN) as a good candidate due to its exceptional physical and chemical properties. The compacted pristine powder (thickness below 1 mm) exhibited, for instance, a solar reflectance above 0.92, better than what we could achieve with titanium dioxide. We report here the development of colloidal suspension of coated boron nitride nanosheets (BNNSs) and its optical characterization. This suspension was used in the formulation of electrophoretic inks. Contrast, time to switch and optical properties were compared to TiO_2-based inks [2] .
Such devices are promising for roof applications, dynamically adapting to heating or cooling needs with minimal energy input.

Keywords:
colloids, boron nitride, radiative cooling, energy savings

References:

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