Bioinspired radiative cooling coating with high emittance and robust self-cleaning for sustainably efficient heat dissipation

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June 30, 2023

Abstract

To overcome the overheating phenomena of electronic devices and energy components, developing advanced energy-free cooling coatings with promising radiative property seem an effective and energy-saving way. However, the further application of these coatings is greatly limited by their sustainability because of their fragile and easy contamination. Herein, we report that a bioinspired radiative cooling coating (BRCC) displayed sustainably efficient heat dissipation by the combination of high emittance and robust self-cleaning property. With hierarchical porous structure constructed by multiwalled carbon nanotubes (MWCNTs), modified SiO2 and FSi resin, the involvement of the BRCC improves the cooling performance by increasing ca. 25% total heat transfer coefficient. During the abrasion and soiling tests, the robust self-cleaning capability endows BRCC-coated Al alloy heat sink with stable radiative cooling performance. Moreover, the simulation and experimental results both revealed that reducing surface coverage of BRCC (ca. 80.9 %) can still keep highly cooling efficiency, leading to a cost-effective avenue. Therefore, this study may guide the design and fabrication of advanced radiative cooling coating.

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