Bio-inspired structures for radiative cooling applications

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Blue Peruvian *Morpho didius* butterfly is a special butterfly species that shows a magnificent iridescent blue color in its wings. This iridescent structural color which plays a dominant role in the overall glossy blue color of the wings has been evolved for survival and recognizability purposes over the years. Earlier investigations of the wing structures had shown that these butterflies have pheromone-producing organs which act as a thermal regulator system within their wings [1]. Inspired by the micro and nanostructures of their wings, in this work, we present a biomimetic model based on the *Morpho didius* butterfly wings which shows potential to be utilized in radiative cooling applications. This biomimicry design involves SiC palm tree-like structures placed in nanoscale separation of a thin film in a vacuum environment. The near-field energy exchange is enhanced significantly by decreasing the dimensions of the tree and rotating the free-standing tree structure by 90 degrees clockwise and also by decreasing the separation distance with the second thin film. This exchange is calculated by using near-field radiative transfer finite difference time domain algorithm [2]. Several orders of enhancement of near-field heat flux within the infrared atmospheric window (8–13 μm bandwidth) are achieved [3]. This spectrally selective enhancement is due to the geometric variations, the spatial location of the source of excitation and the optical properties of the materials, and can be tuned to tailor strong radiative cooling mechanisms.

References

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