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Biomimetics of Passive Radiative Cooling Properties of Silver Ants

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The increasing occurrence of hot summer days causes stress for both humans and animals, particularly in urban areas where temperatures can remain high, even at night. Living nature offers potential solutions that require minimal energy and material costs. For instance, the Saharan silver ant (Cataglyphis bombycina) can endure the desert heat by means of passive radiative cooling induced by its triangular hairs. The objective of this study is to transfer the structural cooling properties of the ant body to various surfaces. Appling the presented techniques on a larger scale, for example on house facades, can decrease the need for conventional cooling and therefore lower the energy demand.

Shrimp shells have been selected as the initial target surface due to their low cost, biodegradability, and similarity in material to the ant body (chitin). Although ultimately shrimp shells turned out to be too hard to be modified with sensitive methods, we found that chitin shows good weather resistance and is therefore suitable for outdoor use cases.

Chemically altered chitin, known as chitosan, has a range of medical uses but can also be processed into a paper-like film. The procedure consists of dissolving chitosan in diluted acetic acid and uniformly distributing it on a flat surface. A structure can then be imprinted onto the film while it is drying. We successfully transferred the structural color of a CD onto the film.

Our ongoing work involves the creation of a polyvinyl siloxane imprint of the ant body. This imprint shall then be transferred onto a chitosan film. By comparing FT-IR spectroscopy measurements of the emissivity of flat and structured film, we intend to demonstrate that it is possible to increase the IR-emissivity and therefore decrease the surface temperature purely through functionalities induced via surface modification.