ADAPTATIONS AUX MILIEUX POLAIRES ET BIOMIMÉTISME

QUAND LES RÉGIONS POLAIRES INSPIRENT

L'INNOVATION

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THERMAL AND OPTICAL ADAPTATIONS OF THE POLAR BEAR'S FUR

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In very early studies, the function of the transparent hair of polar bears with their light scattering hollow core has been associated with fibre-optical properties. Critics, arguing that the distance propagated by the light is too short, later denied this. New spectroscopic, microscopic studies explain the contradiction. The light harvesting mechanism can only be understood as a synergetic cooperation of many of the animal`s hairs. Light is coupled into the hair`s fibre via a scattering process for a short distance where soon after it is coupled out by a subsequent scattering process, just to be coupled again into a neighbouring hair and so on until the light is dissipated into heat or absorbed by the bear`s black skin. In the meanwhile, a small percentage of the incident light is backward scattered. As a result, the pelt`s transparent hairs appear white, while absorbing most of the incident radiation. Moreover, the solar optical technology includes a complementary strategy: the IR -radiation of body`s heat, between 8000 and 12000 nm, is effectively trapped by an analogue mechanism.

The polar bear has been confronted with the challenge of looking white, since he inhabits the snow-white arctic environment, in spite of the high transparency of the keratin. The animal`s energy harvesting mechanism is a compromise between its need to maintain a white appearance for camouflage and the advantage of translucent insulation (harnessing solar radiation to heat the subcutaneous and skin surface layers). The polar bear has been evolving an efficient optical nano-technology for energy harvesting and energy conservation, this should motivate researchers to learn more about this solar energy system and develop technical prototypes. Challenges for a biomimetic energy technology based on Mie scattering are discussed.