University of Fribourg / Faculty of Science and Medicine / AMI - Soft Matter Physics

Order and disorder in natural photonic structures

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Photonic structures in natural organisms are capable of endowing them exceptional optical properties, including beautiful and varied hues, glass like transparencies and highly absorbing blacks. The effect of disorder on the optical properties of these unique photonic structures is investigated through the study of these in numerous species of beetles.

Through the combination of ultrastructural and optical characterization, the colored markings of *Pachyrhynchus* weevils are studied and demonstrated to originate from 3D diamond photonic crystals with varying degrees of order. The principal mechanisms used by the species to tune their appearance are then identified and analyzed as a function of their phylogenetics, giving insight into the development of these structures. The colored patterns of other species, including *Glenea celestis* and *Doliops* are also examined and demonstrated to originate from colloidal crystal structures with varying degrees of order. The remarkable absorptivity of *Euprotaetia inexpectata* beetles, which reaches values above 99.5 % is demonstrated to originate from arrays of disordered micropillars found on their elytra. Through detailed studies and optical simulations, the role of these anisotropic micropillars in enhancing absorption is elucidated.

Inspired by these natural structures, a novel method to create structural colors in edible emulsions using mineral oil droplets is conceptualized. An initial proof of concept for these colored edible emulsions is produced via microfluidics and imaged.

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