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Butterfly wing coloration studied with a novel imaging scatterometer[1]

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Animal coloration functions for display or camouflage. Notably insects provide numerous examples of a rich variety of the applied optical mechanisms. For instance, many butterflies feature a distinct dichromatism, that is, the wing coloration of the male and the female differ substantially. The male Brimstone, *Gonepteryx rhamni*, has yellow wings that are strongly UV iridescent, but the female has white wings with low reflectance in the UV and a high reflectance in the visible wavelength range. In the Small White cabbage butterfly, *Pieris rapae crucivora*, the wing reflectance of the male is low in the UV and high at visible wavelengths, whereas the wing reflectance of the female is higher in the UV and lower in the visible. Pierid butterflies apply nanosized, strongly scattering beads to achieve their bright coloration. The male Pipevine Swallowtail butterfly, *Battus philenor*, has dorsal wings with scales functioning as thin film gratings that exhibit polarized iridescence; the dorsal wings of the female are matte black. The polarized iridescence probably functions in intraspecific, sexual signaling, as has been demonstrated in *Heliconius* butterflies. An example of camouflage is the Green Hairstreak butterfly, *Callophrys rubi*, where photonic crystal domains exist in the ventral wing scales, resulting in a matte green color that well matches the color of plant leaves. The spectral reflection and polarization characteristics of biological tissues can be rapidly and with unprecedented detail assessed with a novel imaging scatterometer-spectrophotometer, built around an elliptical mirror [1]. Examples of butterfly and damselfly wings, bird feathers, and beetle cuticle will be presented.

[1] D.G. Stavenga, H.L. Leertouwer, P. Pirih, M.F. Wehling, Optics Express 17, 193-202 (2009)

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