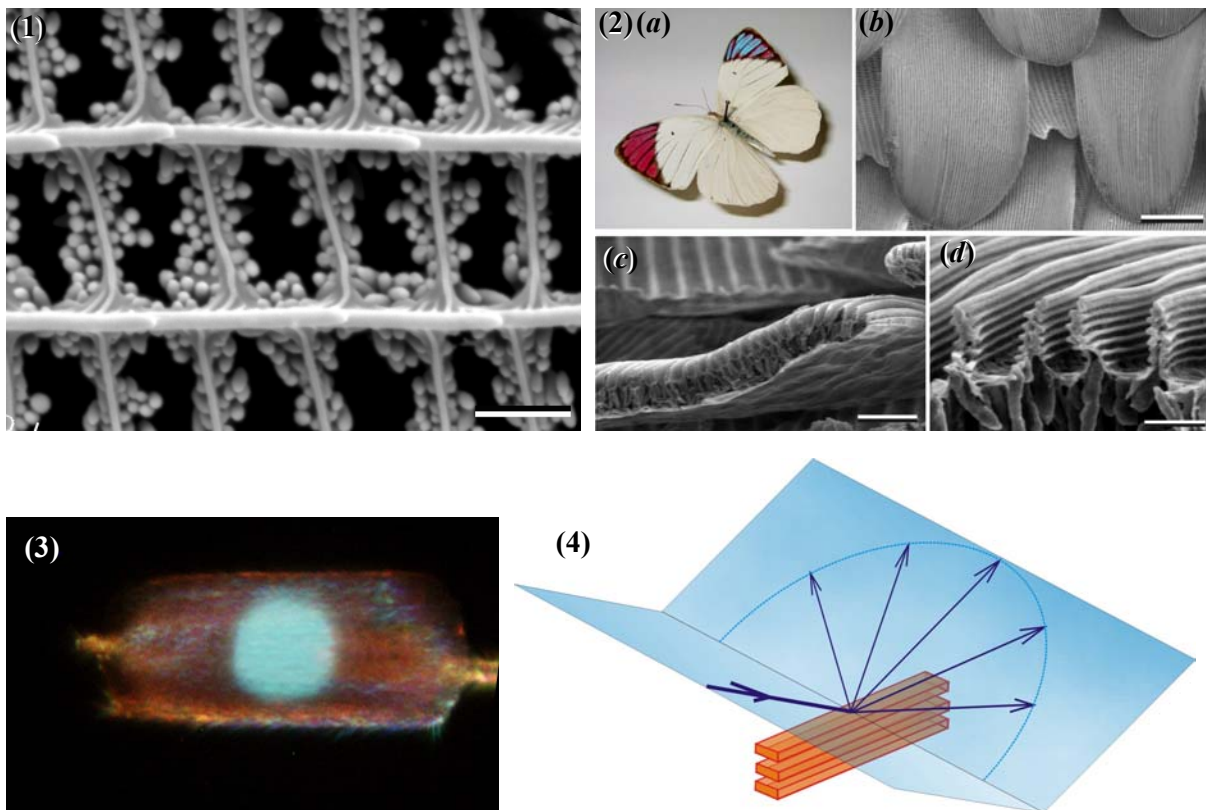


## MICROSPECTROPHOTOMETRY AND SPATIAL SCATTERING PROPERTIES OF SINGLE BUTTERFLY SCALES

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The wing scales of pierid butterflies are studded with beads, whose role in the generation of color is twofold. They scatter light incoherently, proportionally to the density of beads (Stavenga et al. 2004). They also store pigment. We studied two subspecies of *Pieris rapae* (*P. r. rapae* and *P. r. crucivora*). Beads are absent on the dorsal scales of female *P. r. crucivora*, whilst the males have an abundant number of beads that absorb at short wavelengths and scatter considerably at long wavelengths. Coherent scattering by single scales has also been studied. The pierid *Colotis regina* has mainly white wings with absorbing UV pigment, but the scales at the purple tip display a blue iridescence. The angular distribution of single scale reflections of *Colotis regina* and Morpho butterfly scales was measured with a telemicroscopic setup. We measured *M. rhetenor*, *M. aega*, *M. cypris*, *M. sulkowski*, *M. peleides*, and *M. deidamia*. Coherent scattering by Morpho scales yields a line in the far field. With a point source (angular width  $1^\circ$ ), the width of the line for flat scales is around  $7^\circ$  (*M. aega*, *M. cypris*, *M. rhetenor*), but for curved scales over  $60^\circ$  (*Colotis regina*). The angular spread of the line is strongly wavelength dependent. It is around  $100^\circ$  for 500 nm.



**Figure 1.** General structure of a scale: ridges, crossribs, microribs and, as a characteristic of Pierids, beads.

**Figure 2.** (a) *Colotis regina* (family Pieridae). SEM photographs of (b) overview of cover (multilayered and beaded) and ground (only beaded) scales, (c) cross section of a cover scale, (d) multilayers in the ridges of the scale.

**Figure 3.** Single scale of *Morpho cypris*. Area illuminated with a point source ( $\sim 1^\circ$ ).

**Figure 4.** Diagram of the light diffracted by a multilayered ridge.