

Photonic nanostructure in Papilio Butterflies

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In nature, many insects make use of their nano-structure to give optical effect such as iridescence, light detection [1-3]. In fact these nano-structures consist of one-dimensional to three dimensional photonic crystal structures [4, 5]. Among the insects are butterflies which have wings with scales consisting photonic nano-structures. The structures of these butterflies' scales have finer, nano-dimension structures that are responsible for controlling how the incident light reflected back out. This includes not only the colour or wavelengths of light being reflected but also the polarization of the light. In this report, the nano-photonic structures of three Papilionidae butterflies, *Papilio blumei*, *papilio ulyssees*, and *Papilio peranthus*, were investigated. The polarised spectral reflectivity characteristics of the three butterflies were compared, and the physical structures determined. By using optical transmission model combining with the physical measurement, iridescence characteristics that resembled the reflectivity characteristics were derived. It was found that the photonic structure is multi-layer with alternate air and cuticle layers acting as one-dimensional photonic crystal (Fig. 1). The multi-layer structures of the three butterflies differ subtly but are sufficient to account for the difference in their iridescence. The subtleness is more obvious in their polarized transmission results, and simulation shows through varying the layer thickness and its period, the iridescent colour can be controlled. The result lays the foundation to mimic the photonic structures of these butterflies.

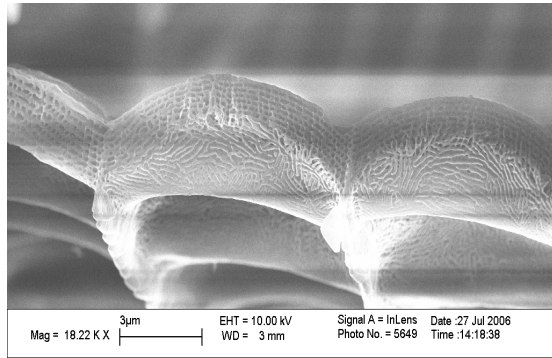


Fig. 1 Cross-section of butterfly wing scale

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