RSoft Application: Nano-Patterned Photonic Structure

Structured Color Inspired by Morpho Butterfly

Overview

A decorative crystal manufacturer in Europe was inspired by the Morpho butterfly to create structured, color-based iridescent crystals for use in their products.

The Challenge

The iridescent color of the Morpho butterfly (figure 1) is not due to pigments or dye. It is the result of a complicated nano-patterned photonic structure on the butterfly wing (figure 2). Rigorous photonic design tools were needed to accurately model the structure.

The Solution

RSoft™ products, in conjunction with LightTools® illumination design software, were used in a mixed-level simulation approach.

▸ RSoft DiffractMOD™ quickly characterized the scattering properties of the nano-patterned surface as a function of incident angle, polarization, and over the visible wavelength range. The data was saved in the RSoft Bidirectional Scattering Distribution Function (BSDF) file format.

▸ A surface property was defined in LightTools with RSoft BSDF User-Defined Optical Properties (UDOP) to ensure a complete data transfer from the rigorous electro-magnetic (EM) DiffractMOD simulation to the LightTools ray tracing simulation.

▸ The nano-patterned surface was illuminated in LightTools with an omni-directional white-light source to calculate the reflected angular luminance.
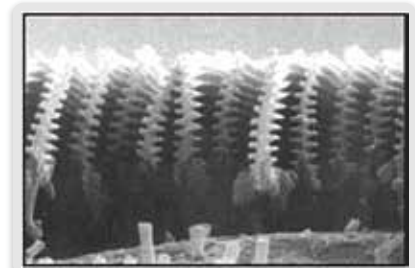

Figure 1. Morpho butterfly

Figure 2. Nano-patterned photonic structure. Image source: Smith et al., "Detailed electromagnetic simulation for the structural color of butterfly wings", Applied Optics, 48 (2009)
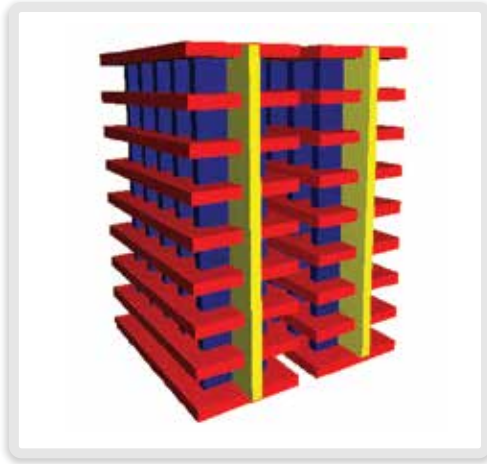
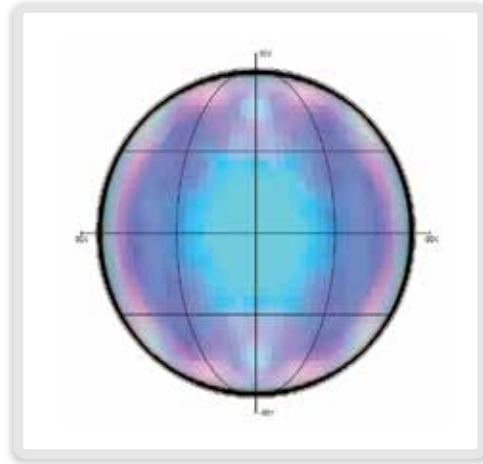Figure 3. Nano-patterned photonic structure modeled in RSoft CAD

Figure 4. Reflected angular luminance calculated by LightTools

The Result

The reflected luminance calculated by LightTools (Figure 4) shows a blue iridescence: light blue is seen when the surface is viewed near the normal axis, and a darker blue is seen off axis.

For more information, please contact Synopsys' Optical Solutions Group at (626) 795-9101, visit http://optics.synopsys.com/rsoft/, or send an e-mail to rsoft_sales@synopsys.com.

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