



SEMINAR SERIES



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Color from colorless materials: Harnessing multi-reflection interference in microstructures

Many of the colors found in nature, such as those of iridescent, color-shifting organisms like beetles, butterflies, and birds, are structural colors. Structural coloration is often generated by optical interference occurring within nanoscale periodic structures, like diffraction gratings, photonic crystals, or thin films. In these cases, the periodicity of the structure is similar to the wavelength of the visible light undergoing interference. However, I will describe the interesting observation and mechanism behind how optical interference and iridescent color can be generated by light interacting within much larger, microstructure structures. In this mechanism, light reflecting multiple times (such as by total internal reflection or a mirrored surface) and traveling along different paths within a microstructure can optically interfere. This effect happens in materials as simple as water droplets, but it can also be harnessed within far more complex 3D polymeric geometries to customize the interference. Ray tracing simulations coupled with color visualization and spectral analysis techniques can be used to model, examine, and rationalize the iridescence generated for a range of micro-geometries, including hemicylinders, hemispheres, truncated hemispheres, and other irregular structures under varying illumination conditions. Microstructure arrays patterned on surfaces with varying orientation and size lead to unique color-traveling optical effects and highlight opportunities for how multibounce reflection interference can be used to create customizable colored appearances. The findings provide a conceptual framework for rationalizing the multibounce interference mechanism and establish approaches for characterizing and tailoring the optical and iridescent properties of microstructured surfaces.

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