# Butterfly wings may help scientists better understand photonic crystals

September 4 2008, By Miranda Marquit

As technology moves forward, many scientists are looking to nature to find inspiration for the development of advanced materials that can have a variety of practical applications.

Among the structures being studied are butterfly wings. Akhlesh Lakhtakia, a professor at Pennsylvania State University, worked with professors Raúl Jose Martín-Palma and Carlo Pantano to demonstrate a technique for replicating butterfly wings. Their work, which could have an impact on photonics, is published in *Applied Physics Letters:* "Biomimetization of butterfly wings by the conformal-evaporated-film-by-rotation technique for photonics."

"The wings of the butterflies of some species have some very interesting properties that make them attractive for people working in optics," Lakhtakia tells *PhysOrg.com*. "They have a regular array of scattering elements, and no matter the angle of light that shines on them, they reflect the same wavelength of light, more or less."

Lakhtakia explains that butterfly wings, for example those from the genus Morpho, exhibit characteristics of what is known as structural color. "Chemical color is intrinsic color; dyes, for example, have this intrinsic color. Structural color is different. When while light – which contains all the colors – hits an object, all the wavelengths go through, except a narrow range that is reflected back. That reflected color is what we see. Because its wavelength range is so narrow, the color will be pure and intense."

With the butterfly wings, Lakhtakia says, the scattering elements that create the vibrant colors are “natural photonic crystals. These are little tiny balls or plates, but the effect is the same. These are photonic crystals that we can study mathematically, but cannot always by made.”

In order to get closer to making these photonic crystals, the three Penn State scientists devised a process that allowed them to replicate butterfly wings. “We deposited a thin coating of a special kind of glass, called chalcogenide. This coating was wrapped closely around the butterfly wing,” Lakhtakia explains. “Then we used a procedure called plasma ashing to destroy the wing, removing it and leaving the glass.” The result, he continues, “is a positive mold that looks the same as the butterfly wing from the top.”

Lakhtakia and his colleagues believe that there are several applications that could be enhanced through research of these butterfly wing replicas. “This could lead to smaller electronic circuitry, since it could lead to ultraviolet optics to fabricate semiconductor devices.” He also sees uses at infrared wavelengths. “There aren’t many materials that are useful with infrared, but this could help. Some of the applications include sensors for the military and police.”

All of these possible applications are what need to be addressed in the next phase of research. “We’ve reported the process of making replicas,” Lakhtakia says, “and now, beyond making them better and faster, we need to also focus on what they can be used for.” He and his colleagues are most interested in the photonic capabilities, as well as the possibility that studying butterfly wings could lead to better solar energy concentrators.

“There are many possibilities. Once you make a structure, people tend to come up with ideas of how it can be used.”