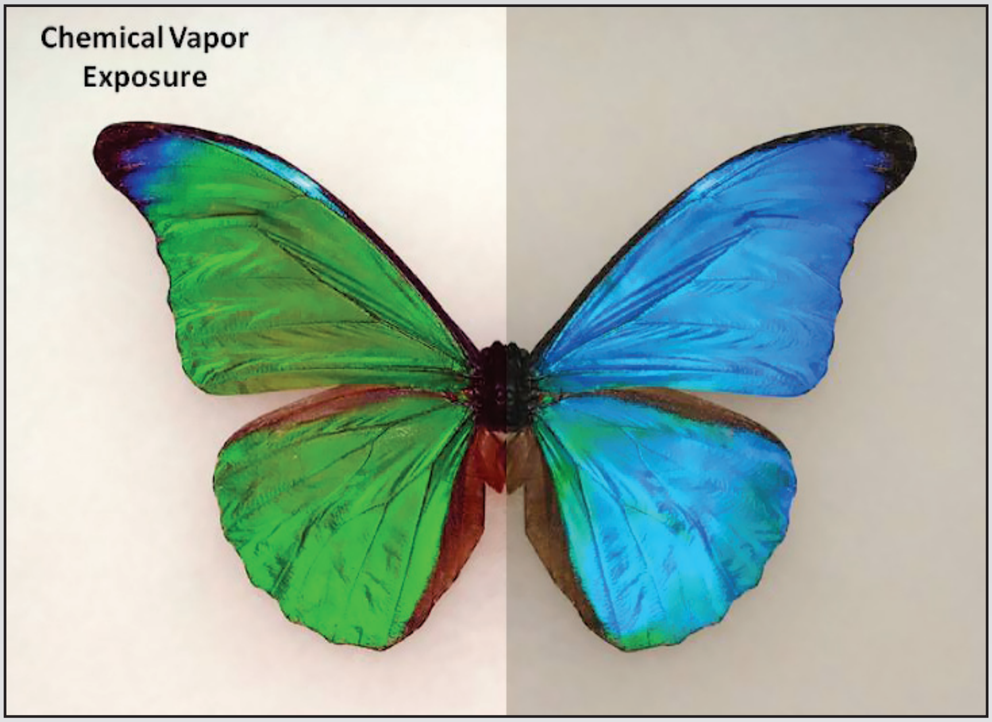
Butterfly Biology Inspires New Sensing Capability



A Morpho butterfly wing exposed to a chemical vapor (pictured left), as compared to the insect's normal wing (pictured right) (AFRL image)

A collaboration of AFRL, General Electric (GE), and academic researchers are leveraging the chemical sensing properties of butterflies to develop nanostructured photonic sensors that, if implemented, would not only enable faster and more selective detection of dangerous chemical warfare agents and explosives, but also expedite the development of responsive materials for countering the harmful entities. The bio-inspired sensing technology will thus have a variety of important military and commercial uses in this vein.

Since their discovery 3 years ago that the nanostructures present on butterfly wing scales exhibit acute chemical sensing properties, GE scientists have been working to develop a new sensing platform that replicates these unique characteristics. Throughout their endeavor, the researchers have observed—and been motivated by—countless examples of naturally occurring optical structures with properties arising from an intricate morphology. For instance, the brilliant hues seen in butterfly wings, beetle carapaces, and peacock feathers are due largely to structural complexity, not simply color. The Defense Advanced Research Projects Agency (DARPA) is attempting to harness the best of nature's own photonic structures while exploiting advances in materials technology in order to create controllable photonic devices at visible and near-infrared wavelengths. As part of DARPA's recent funding of an effort to examine the technology's feasible use in improving homeland security, AFRL and GE joined forces with scientists from the State University of New York at Albany and the University of Exeter, United Kingdom, to conduct the necessary research.

The team's results indicate that the biologically based sensing platform could dramatically increase sensitivity, speed, and accuracy in the detection of hazardous chemical threats. The devices can be very small, and their diminutive aspect—coupled with their inherently low production costs—will permit their ready manufacture and deployment wherever needed. These size and production advantages, combined with the unique sensing capability itself, could extend the technology's use to a host of commercial applications, including emissions monitoring, food and beverage safety monitoring, water purification testing, breath analysis for disease detection, and wound healing assessment.