Using light to change the makeup of plastics

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A FAMU-FSU College of Engineering professor is using rays of light to control the shape of a special type of plastic, a project that could have long-term implications for manufacturing, solar energy harvesting, aerospace flow control and robotic actuators.

Mechanical engineering Associate Professor William Oates is in the midst of a four-year project supported by the Air Force Office of Scientific Research to test the possibilities of how light can change the shape of plastics and how those changes could help robots perform different tasks, like grip materials through adhesion. It is a collaborative project with a colleague in chemical engineering, Associate Professor Anant Paravastu.

"We are using light to control the structure of the material," Oates said. "You can basically make the plastic bend and twist through a special type of photochemical reaction."

The work is being funded by a $580,000 grant from the Air Force Office of Scientific Research.

But, the process of exploration is done on a very small scale.

Oates and his graduate students use a light emitting diode (LED) and focus it on a tiny piece of plastic. The piece is currently only about as thick as an insect wing.

"The light is a little brighter than the sun," Oates said.

The work on this project originally started in 2009 when Oates won a Young Faculty Award from the Defense Advanced Research Projects Agency that provided him with some initial funding and has been extended through an NSF CAREER grant.

His work caught the attention of both the Air Force and other researchers at Florida State who were working on robots to see how they could collaborate.

"It's great because I have so many colleagues working on different projects and sometimes our work can overlap," Oates said.

Oates' work may also result in the creation of cilia, the tiny hair-like structures on cells that are used for movement, biological adhesion, and to gather food. Oates and Ken Hanson, an assistant professor in chemistry, are working with a start-up company to see if it is possible to use a 3D printer to make these adaptive materials and structures respond to light in a much more efficient and novel manner.

"Hopefully, we'll begin to see our technology transition to novel applications in the years ahead," Oates said. "There have been many other 'smart materials' utilized in commercial applications such as ultrasound devices using piezoelectric materials and bio-medical stents using shape memory alloys. The use of light to control the shape of a structure provides an entirely new opportunity to manipulate engineering structures without using wires or heat to control the material."

Provided by Florida State University