Super-black nano-coating to be tested for the first time in space

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A new carbon-nanotube coating is one of several materials to be tested on the International Space Station as part of the Materials Coating Experiment. The super-black material occupies the "D" slot on the sample tray. Credit: NASA/Bill Squicciarini

(Phys.org) —An emerging super-black nanotechnology that promises to make spacecraft instruments more sensitive without enlarging their size

will be tested for the first time on the International Space Station within a year.

The nano-based material is a thin, highly uniform coating of multi-walled nanotubes made of pure carbon about 10,000 times thinner than a strand of human hair. "Though tested extensively in ground-based laboratories, the material has never flown in space," said NASA Principal Investigator John Hagopian, an optics engineer at NASA's Goddard Space Flight Center in Greenbelt, Maryland, who has pioneered the technology's development. "The objective is to determine how well this coating survives the harsh space environment."

The carbon-nanotube coating, whose development is six years in the making, is considered especially promising as a technology to reduce stray light, which can overwhelm faint signals that sensitive detectors are supposed to retrieve.

Ground-based laboratory testing has proven that the coating absorbs 99.5 percent of the light in the ultraviolet and visible and 99.8 percent in the longer or far-infrared bands. Currently, instrument developers apply black paint on baffles and other instrument components to reduce errant light. However, these techniques absorb only 90 to 96 percent of the light—far underperforming the carbon-nanotube coating, Hagopian said.

The coating's super-absorbency is due to the fact that the nanotubes are mostly empty space; however, the carbon atoms that occupy this fine forest of tiny nested tubes absorb the light and prevent it from reflecting off surfaces. Because only a tiny fraction of light reflects off the coating, the human eye and sensitive detectors see the material as black—in this case, extremely black.

This image shows the Robotic Refueling Mission-Phase 2 task board that will be installed on the orbital outpost's Express Logistics Carrier 4. The Materials Coating Experiment can be seen on the left. Credit: NASA Goddard/Chris Gunn

Hitching Ride on NASA's RRM Payload

The experiment, which consists of two trays containing two titanium discs coated with the carbon nanotubes as well as other NASA coating samples, hitched a ride on one of the new task boards for NASA's Robotic Refueling Mission (RRM)- Phase 2. This is a follow-up investigation to the RRM payload currently installed on the orbital outpost's Express Logistics Carrier 4 (ELC4).

RRM-Phase 2 launched aboard the Automated Transfer Vehicle from French Guiana on July 29 and arrived at the International Space Station on Aug. 12. RRM-Phase 2 will test tools and techniques for on-orbit satellite servicing. The trays will be exposed to space for one year and then returned to Goddard for evaluation. They are unrelated to the mission's primary goal of testing the satellite-servicing components.

"I'm just pleased that the demonstration had room for our samples," Hagopian said. "We've made great progress on the coating, developing and testing new ways to lay down the carbon-nanotube coating. We are focusing on making our coatings robust and not necessarily the blackest for now. What we lacked in our development program was access to space. Now we'll have that."

During its one-year stay, the experiment will be exposed to harsh radiation and other elements, including atomic oxygen that reacts with spacecraft materials and corrodes them. Knowing whether the coating can withstand the extreme environmental conditions will help further qualify the technology for potential use on space-based instruments, Hagopian said.

This is important, he added. "This coating has great potential to help make instruments more sensitive without enlarging their size," he said. "The technology demonstrates the power of nanoscale technology, which is a particularly applicable to a new class of less-expensive tiny satellites called CubeSats that NASA is pursuing to reduce the cost of space missions."

Provided by NASA

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