Materials face ultimate test in space

April 29 2011

(PhysOrg.com) -- Mark Hersam of Northwestern University will be more interested than most Americans when the space shuttle Endeavour lifts off for the last time Friday, April 29. Six little pieces of himself and his research team -- scientific samples each a square inch in size -- will be on board.

His carbon nanotube and graphene thin films will spend at least six months mounted on the outside of the International Space Station to see if they degrade in the harsh environment of outer space or are stable. Radiation damage is a major issue with materials used in spacecraft.

“Our samples must go into space to prove themselves,” said Hersam, a professor of materials science and engineering in the McCormick School of Engineering and Applied Science. “This is the ultimate test. If the materials are resistant to radiation there, they could be used to dramatically improve the technology currently used in space, such as that found in satellites.”

The samples are part of NASA’s Materials International Space Station Experiment (MISSE), a series of experiments investigating the effects of long-term exposure of various materials to the harsh space environment. The project evaluates the performance, stability and long-term survivability of materials and components planned for use by NASA and others.

Liam Pingree, a Northwestern alumnus and former graduate student of Hersam’s, secured a place on the shuttle for Hersam’s transparent

conductive materials. “Is a single-walled carbon nanotube material more stable than a graphene sheet?” Pingree said. “I don’t think anyone knows the answer to that without putting the materials up into space.” He is a research engineer at Boeing Research & Technology.

Hersam has a second duplicate set of the samples -- “terrestrial controls” -- safely held in his lab. Once the first set returns from space, Hersam and his team will test the two sets and compare them.

“Ideally we want the space samples to perform as well as or better than our lab samples,” Hersam said. “It’s possible the space samples could be superior due to differences in atmospheric conditions.”

He also will be able to monitor from Earth the electrical resistance of one of the graphene sheet samples while it is in space. If the material degrades, its resistance will increase, Hersam said.

His lab specializes in producing exceptionally high purity samples of carbon nanotube and graphene thin films. Hersam and his research team have shown performance enhancement using these materials in (Earthly) applications ranging from high-frequency transistors for communication systems to transparent conductors, which are used in solar cells and displays. If the materials pass the outer space test, they could be used in similar applications in space.

“It’s very difficult to get experiments on the space shuttle so we are very excited and thank Liam for making it happen,” Hersam said. “The technology we have on Earth is considerably more advanced than what is used in space, due to the difference in radiation. The computers used on Earth, for example, are generations ahead of those used in space because modern terrestrial devices are not immune to the radiation found in space.”

Hersam's colleague Peter Voorhees knows the feeling of having an experiment in space. Voorhees, the Frank C. Engelhart Professor of Materials Science and Engineering, has had three coarsening experiments on the space station; the most recent samples returned last month on the shuttle Discovery.

There is only one more shuttle -- Atlantis -- slated to launch (June 28) to the International Space Station, ending the space shuttle program's 30-year career. This means that Hersam's samples will need to find a different way back to Earth.

Provided by Northwestern University