



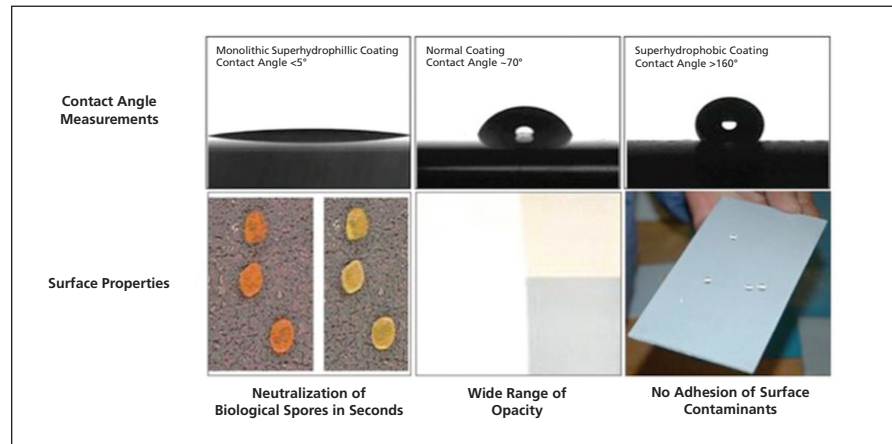
## Radiation-Resistant Hybrid Lotus Effect for Achieving Photoelectrocatalytic Self-Cleaning Anticontamination Coatings

Initial results are promising.

*Goddard Space Flight Center, Greenbelt, Maryland*

An experiment involving radiation-resistant hydrophobic coatings is planned for space exposure and experimental testing on the International Space Station (ISS) in 2011. The Lotus biocide coatings are designed for supporting space exploration missions. This innovation is an antibacterial, anti-contamination, and self-cleaning coating that uses nano-sized semiconductor semimetal oxides to neutralize biological pathogens and toxic chemicals, as well as to mitigate dust accumulation (see figure).

The Lotus biocide coating is thin (approximately microns thick), lightweight, and the biocide properties will not degrade with time or exposure to biological or chemical agents. The biocide is stimulated chemically (stoichiometric reaction) through exposure to light (photocatalysis), or by an applied electric field (electrocatalysis). The hydrophobic coating samples underwent preliminary high-energy proton and alpha-ray (helium ion) irradiations at the Lawrence Berkeley National Laboratory 88" cyclotron and demonstrated excellent radiation resistance for a portion



The first row of photos shows the **Behavior of a Water Droplet's Contact Angle** on superhydrophilic, normal, and superhydrophobic coated surfaces. Little or no change in the contact angles was observed following irradiation of the coatings by gamma-rays and high-energy protons. The bottom row of photos illustrates that radiation-resistant self-cleaning coatings also offer the potential to reduce terrestrial and extraterrestrial cleaning requirements on surfaces while providing biocidal and spore-repellent features.

of the Galactic Cosmic Ray (GRC) and Solar Proton spectrum. The samples will undergo additional post-flight studies when returned to Earth to affirm further the radiation resistance properties of the space exposed coatings.

*This work was conducted by Edward W. Taylor of International Photonics Consultants and Ronald G. Pirich of Northrop Grumman for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC 16117-1*

## Improved, Low-Stress Economical Submerged Pipeline

**This technology can safely transport large quantities of fresh water, oil, and natural gas underwater for long distances.**

*NASA's Jet Propulsion Laboratory, Pasadena, California*

A preliminary study has shown that the use of a high-strength composite fiber cloth material may greatly reduce fabrication and deployment costs of a subsea offshore pipeline. The problem is to develop an inexpensive submerged pipeline that can safely and economically transport large quantities of fresh water, oil, and natural gas underwater for long distances. Above-water pipelines are often not feasible due to safety, cost, and environmental problems, and present, fixed-wall, sub-

merged pipelines are often very expensive.

The solution is to have a submerged, compliant-walled tube that when filled, is lighter than the surrounding medium. Some examples include compliant tubes for transporting fresh water under the ocean, for transporting crude oil underneath salt or fresh water, and for transporting high-pressure natural gas from offshore to onshore.

In each case, the fluid transported is lighter than its surrounding fluid, and

thus the flexible tube will tend to float. The tube should be ballasted to the ocean floor so as to limit the motion of the tube in the horizontal and vertical directions. The tube should be placed below 100-m depth to minimize biofouling and turbulence from surface storms. The tube may also have periodic pumps to maintain flow without over-pressurizing, or it can have a single pump at the beginning. The tube may have periodic valves that allow sections of the tube to be repaired or maintained. Some exam-