

Water Phobic Powder Coatings Promise Breakthrough in Energy Saving Strategies

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Technology Summary

Researchers at ORNL have developed a set of high quality materials and coatings with remarkable water repellency. Called superhydrophobic (SH) coatings, they are composed of powders that have demonstrated some of the best water repellency properties ever reported. Among the coatings and materials developed thus far, the clear transparent coatings show great promise for a broad suite of commercial applications. The coatings can be applied to a broad range of substrates and materials, including metal, glass, plastic, wood, and fiberglass. The coatings feature a contact angle of ~ 170 degrees, accounting for their superhydrophobic behavior, optical clarity, and transparency over a broad spectrum (300–1500 nm). They can be sprayed onto virtually any surface.

The key to developing the highly water repellent coatings is the creation of nanostructured powders, in which each powder grain is characterized at the nanoscale with specific features that amplify surface tension effects. The powder grains must be < 200 nm in diameter to prevent light scattering, which would cloud the coating. Then the particles are treated with a water repellent chemical and uniformly dispersed on a thin film. Last, the coated thin film is bonded to a substrate, which makes the coating durable without substantially reducing the nano-textured features of the powder.

One of these coatings is based on a commonly available material, diatomaceous earth, which is formed from the silica skeletal remains of freshwater diatoms that lived millions of years ago. These structures range in size from 5 to 50 microns but contain nanometer-sized surface features that produce water repellency when the surface is chemically treated.

ORNL researchers are exploring the use of solvents and bonding materials to produce surfaces that are not only highly water repellent but also strongly bonded to the substrate surface, and consequently, are very durable. These powder-based treatments can be applied to very large surface areas using conventional spray coating and painting.

Advantages

The introduction of SH powders into industrial, transportation, and consumer products could lead to a breakthrough in energy savings with related economic and environmental benefits.

Potential Applications

The powders can be used to coat water pipes, resulting in a substantial reduction in the energy used to transport water and impeding the growth of algae on the surfaces of water systems. Water repellent coatings can be advantageously applied to large-scale structures, such as boat hulls, bridges, decks, and almost any exposed structure that requires protection from rain.

Patent

Brian R. D'Urso and John T. Simpson, *Composite Ordered Materials Having Sharp Surface Features*, U.S. Patent 7, 150, 904, issued December 19, 2006.

Inventors

Brian R. D'Urso and John T. Simpson
Measurement Science and Systems Engineering
Division
Oak Ridge National Laboratory

Licensing Contact

Gregory C. Flickinger
Technology Commercialization Manager,
Energy and Engineering Sciences
UT-Battelle, LLC
Oak Ridge National Laboratory
Office Phone: 865.241.9485
E-mail: flickingergc@ornl.gov

