New polymer developed

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New coating becomes water repellant when wet; applications include medical diagnostic equipment

A Virginia Commonwealth University chemical engineering team has developed a novel material that becomes water repellent when wet, setting the stage for advances in engineering, medicine and diagnostics.

In the April 26, 2005, issue of the journal Langmuir, a publication of the American Chemical Society, Kenneth J. Wynne, Ph.D., a professor in the VCU School of Engineering's Department of Chemical Engineering, and Umit Makal, a graduate student at VCU, created a enigmatic polymer that is hydrophilic, or water loving, when dry, and hydrophobic, or water resistant, when wet; opposite of most materials.

Makal drew an analogy of the research to a drop of water in a Teflon-coated pan. "Water in such a pan just rolls off," he said. "On our surface, when the pan is dry, water just loves the surface … it tries to stick to the surface."

"This discovery runs counter to intuition," Wynne said. "Water-induced hydrophobic surfaces may lead to applications for many things, including the testing of bodily fluids, switching devices, drag-reducing coatings and many others.

"Sometimes an engineer wants to guide the flow, or turn off tiny streams of fluid, such as blood, in a test tube, and this kind of phenomenon could be useful in creating channels for that purpose."

Wynne and Makal actually were working to create antimicrobial coatings by incorporating a molecule called hydantoin into fluorine-containing polymer chains. Makal was testing the behavior of water on one of these coatings and observed that the water drops were spreading, wetting the surface.

"After we took the drop off and put it back again, it started hating the water," Makal said. "The surface became water repellent where the original drop of water had been."

Wynne and Makal concluded that the change was caused by a rearrangement of the polymer side chain, which exposed the hydrophobic, fluorine-containing groups to the surface and made them repel water.

"The process can be reversed by drying the surface," Wynne said.

Source: Virginia Commonwealth University