# Sticky Surfaces Turn Slippery With the Flip of a Molecular Light Switch

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Changing a surface from sticky to slippery could now be as easy as flipping a molecular light switch. Researchers at Rensselaer Polytechnic Institute have created an "optically switchable" material that alters its surface characteristics when exposed to ultraviolet (UV) light. The new material, which is described in the June 19 issue of the journal *Angewandte Chemie International Edition*, could have a wide variety of applications, from a protein filter for biological mixtures to a tiny valve on a "lab-on-a-chip."

Synthetic polymer membranes are used in a variety of applications based on the science of "bioseparation" — filtering specific proteins from complex liquid mixtures of biological molecules. But proteins often stick to these membranes, clogging up their pores and severely limiting their performance, according to Georges Belfort, the Russell Sage Professor of Chemical Engineering at Rensselaer and corresponding author of the paper.

"We asked ourselves, can one use light to help the proteins hop on and hop off? We have shown that when one changes light, the proteins don't stick as well," Belfort says.

Operators need an inexpensive way to clean these membranes while they are still in place, rather than periodically removing them from the application environment, Belfort says. But currently the only cleaning options involve expensive chemicals or labor-intensive procedures that result in significant process down-time.

To make the new materials, Belfort and his coworkers attached spiropyran molecules to a widely used industrial polymer, poly(ether sulfone). Spiropyrans are a group of light-switchable organic molecules that exist in a colorless, "closed" form under visible light, but switch to a reddish-purple, "open" form when exposed to UV light. This change leads to an alteration of the new material's polarity, or the chemical structure of its atoms.

In switching from non-polar to polar, the material becomes less attractive to proteins that might stick to its surface, according to Belfort. Exposing the material to UV light is like flipping a molecular switch, causing sticky proteins to detach from the surface and wash away in the liquid, the researchers report.

Not only is the switching mechanism uncomplicated, but so is the patented procedure required to graft spiropyran molecules to poly(ether sulfone). "We used a relatively simple two-step process that could be easily incorporated into a commercial manufacturing process," Belfort says. "The relative ease of this grafting and switching process suggests many industrial opportunities.

In addition to bioseparations, Belfort envisions a number of potential applications for the materials, ranging from new membranes for treating polluted water to the targeted release of drugs in the body.

For example, in recent years researchers have developed "lab-on-a-chip" technology for automating laboratory processes on extremely small scales. Belfort notes that the new material could be employed as a surface valve that can be opened and closed by applying light, offering the ability to control liquid flow in a chip's ultra-tiny channels.

And in sensors designed to detect biological agents, the ability to control the polarity of the membrane could help reduce the attachment of unwanted proteins, providing more accurate readings, according to Belfort.

Two other Rensselaer researchers contributed to the project: Arpan Nayak, a graduate student in chemical and biological engineering; and Hongwei Liu, a post-doctoral research associate in chemical and biological engineering.

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The paper, which is titled "An Optically Reversible Switching Membrane Surface," can be found on pages 4,094-4,098 in Volume 45, Issue 25, of *Angewandte Chemie International Edition*.

Source: Rensselaer Polytechnic Institute