Researchers create 'green' process to reduce molecular switching waste

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Ivan Aprahamian, an associate professor of chemistry at Dartmouth College. Credit: Dartmouth College

Dartmouth researchers have found a solution using visible light to reduce waste produced in chemically activated molecular switches, opening the way for industrial applications of nanotechnology ranging from anti-cancer drug delivery to LCD displays and molecular motors.

The study appears in the *Journal of the American Chemical Society*.

Chemically activated molecular switches are molecules that can shift controllably between two stable states and that can be reversibly switched—like a light switch—to turn different functions "on" and "off." For example, light-activated switches can fine-tune anti-cancer drugs, so they target only cancer cells and not healthy ones, thereby eliminating the side effects of chemotherapy.

But such switches typically generate waste and side products that are problematic. One way of making these processes cleaner is by using light energy, similar to how photosynthesis operates in nature. In their experiments, the researchers show that a merocyanine-based photoacid derivative can effectively be used in a switching process that is fast, efficient and forms no wastes.

"We address a bottleneck that's been hampering the field for decades—what to do with the accumulated salts and side products when activating such switches," says co-author Ivan Aprahamian, an associate professor of chemistry. "Acids, bases and other compounds need to be constantly added to the mix to make sure the system can be switched, but within a few cycles there is so much waste that it interferes with the switching process. We found a neat solution by coupling an efficient photoacid to our chemically activated hydrazone switch. We showed the system can be efficiently modulated more than 100 times with no accumulation of waste or degradation. We are using visible light to accomplish this, so in reality we are converting light energy into a chemical output, similar to what happens in photosynthesis. You can look at this as a 'green' process that closes the loop in a nanotech-related process, and it will reduce waste in future industrial applications of molecular switches."