Chemists examine solar energy and air purification

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The abundant sunlight is no doubt making beachgoers happy this summer, but those working on their tans aren't the only beneficiaries. The sun's rays are also a key ingredient to going green.

Solar light can be used to help purify air and water and produce valuable chemicals that contribute to energy efficiency. A Rutgers–Camden professor says all that is possible through a process called photocatalysis.

"Photocatalysis is a chemical reaction that occurs under the influence of solar light," says Alexander Samokhvalov, an assistant professor of chemistry at Rutgers–Camden. "I'm researching the fundamental chemistry of how sunlight can drive chemical reactions."

In particular, the chemist is studying how water is broken down into its hydrogen and oxygen components using sunlight and a solid photocatalyst. Producing hydrogen-powered vehicles is an example of one "green" application of splitting water.

Samokhvalov is the recipient of the Cottrell Science Award from the Research Corporation for Science Advancement. The foundation provides funding for innovative scientific research and the development of academic scientists.

In addition to the two-year, $45,000 Cottrell award, Samokhvalov received a $5,000 grant from the Rutgers University Research Council for his work with photocatalysis.

Photocatalyst technology is receiving attention as an immediate means of reducing urban air pollution. Samokhvalov says come examples of this technology at work are self-cleaning windows, which chemically break down adsorbed dirt in sunlight, and portable air purifiers, like the one that sits in Samokhvalov's office on the Rutgers–Camden campus.

In both cases, the photocatalyst is titanium dioxide, or TiO2, which is commonly found in sunscreen because of its ability to absorb ultraviolet light. Samokhvalov says TiO2 utilizes ultraviolet light to remove or break down harmful air pollutants.

On exposure to sunlight, the titanium dioxide reacts with contaminants in water or air and breaks them down into harmless substances. The compound has other applications when used as a photocatalyst, like converting greenhouse gas into liquid clean fuels.

"By modifying and further developing this technology, we can continue to reduce pollution in our air and water," the Rutgers–Camden chemistry scholar says. "But what is acutely missing in many research papers on photocatalysis is how electrons in the solid photocatalyst actually behave upon absorption of light to drive chemical reactions. This is something I would like to investigate."

He continues, "It is of the fundamental interest to understand if electron transfer occurs in the direct vicinity of the atom that absorbs the energy of a photon, or if the chemical reaction occurs somewhere far from the place where the photon was actually absorbed. Modern scientific instrumentation, a bit of imagination and work in the lab may answer this question."

The Cottrell Science Award includes funding for an undergraduate summer research fellowship and will help fund the purchase of an apparatus used in the research.

Samokhvalov has several undergraduate students working with him on the project.

"I believe that it is important that the interested undergraduate researcher is engaged into explorative experimental work throughout academic year," he says.

Samokhvalov says, "The Cottrell Science Award is an endorsement of the increasing importance of undergraduate research in chemistry in the emerging fields of the clean and sustainable energy."

Provided by Rutgers University