Lotions, perfumes curb potentially harmful effects of human oxidation field, study finds

UC Irvine scientist supported research by creating state-of-the-art chemical model.
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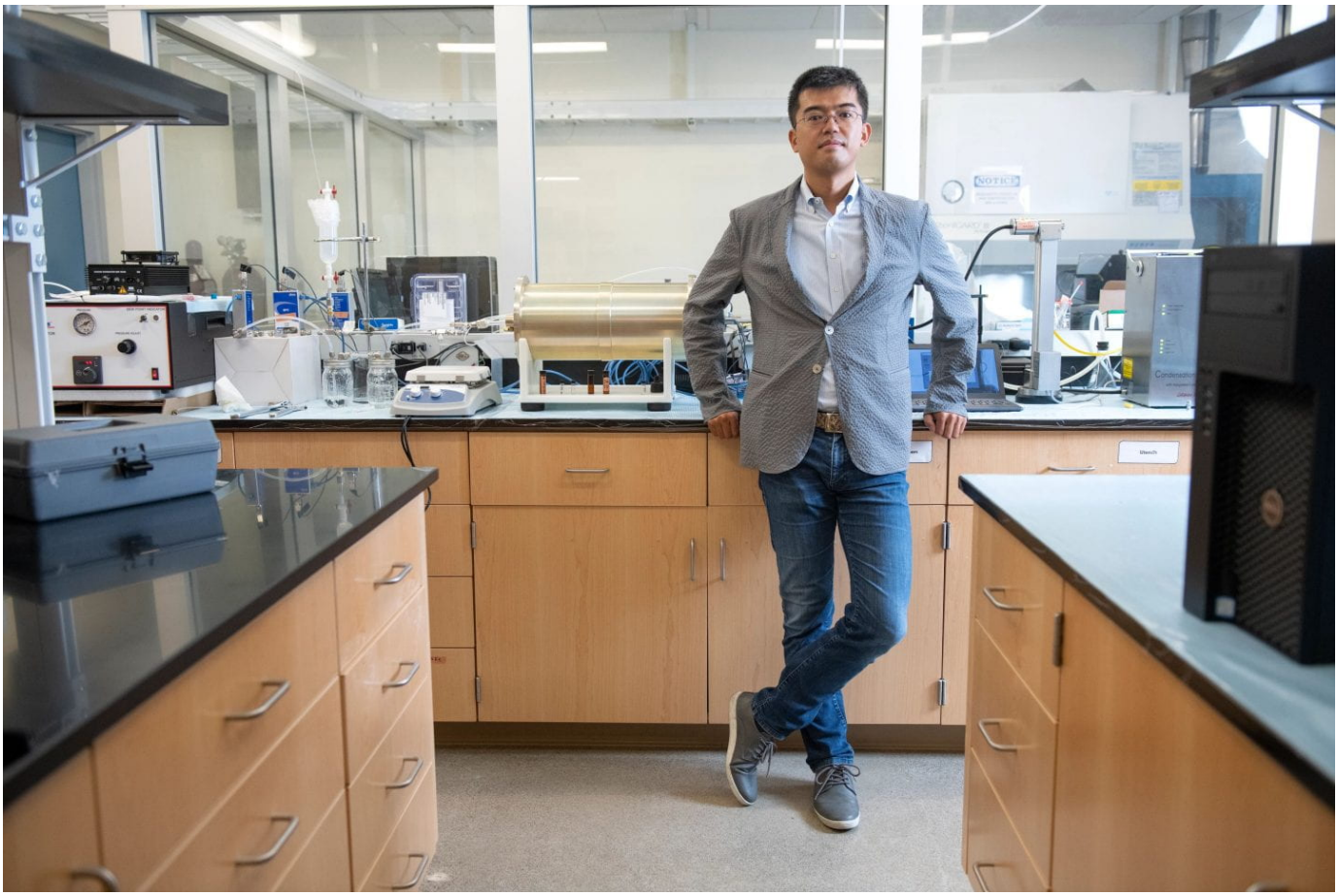

Manabu Shiraiwa, UC Irvine professor of chemistry, oversaw the development of a state-of-the-art chemical model that was used to gain a better understanding of the impact of lotions, perfumes and other personal care products on indoor air quality, especially when combined with the “human oxidation field” created when oils and fats on our skin interact with ozone and other chemical compounds in the surrounding air.

Picture Credit:
Steve Zylius / UC Irvine

Irvine, Calif., May 21, 2025 — In a paper published today in *Science Advances*, researchers at the University of California, Irvine, Germany's Max Planck Institute for Chemistry, Pennsylvania State University and other international institutions report that the application of personal care products such as fragrances and body lotions suppresses a potentially unhealthy "human oxidation field" that exists around our bodies.

This zone, which was the subject of a paper by the same team published in *Science* in 2022, is created when oils and fats on skin react with ozone, an important oxidant in the indoor environment. Combined with emissions from cooking, cleaning, smoking, interior paint, rugs and furnishings and the introduction of ozone transported from outdoors, this close-to-body region – in which highly reactive compounds called hydroxyl radicals are present – has the potential to substantially impact indoor air quality and human exposure to indoor pollutants.

In the paper, the researchers report that body lotion hinders the generation of a key hydroxyl radical precursor by acting as a physical barrier between ozone in the air and squalene – a naturally occurring oil – on skin. They also found that ethanol solvent in fragrances acts as a hydroxyl radical sink, which reduces the strength of the human oxidation field.

Co-corresponding author Manabu Shiraiwa, UC Irvine professor of chemistry, led the creation of a multiphase chemical kinetic model and collaborated with researchers at Penn State to build a computational fluid dynamics model to demonstrate how concentrations of the reactive components accrue indoors.

"Our team took a unique approach to simulate concentrations of chemical compounds near humans in the indoor environment," Shiraiwa said. "We developed a state-of-the-art chemical model that can simulate reactions of ozone with human skin and clothing that can lead to the formation of [hydroxyl radicals] and semi-volatile organic compounds."

The authors said that their findings have substantial implications for indoor air chemistry, the air quality of occupied spaces and human health since many of the chemicals in our immediate vicinity are transformed by the human oxidation field.

“If we buy a sofa from major furniture company, it’s tested for harmful emissions before being put on sale. However, when we sit on the sofa, we naturally transform some of these emissions because of the oxidation field we generate,” said lead author Jonathan Williams, who heads the study of organic reactive species at the Max Planck Institute for Chemistry. “This can create many additional compounds in our breathing zone whose properties are not well known or studied. Interestingly, body lotion and perfume both seem to dampen down this effect.”

The work was part of the Indoor Chemical Human Emissions and Reactivity project, which brought together collaborators from Denmark, Germany and the United States. Computer modeling was provided by the Modelling Consortium for Chemistry of Indoor Environments, based at UC Irvine and led by Shiraiwa. Both efforts were funded by grants from the Alfred P. Sloan Foundation.

About UC Irvine’s Brilliant Future campaign: Publicly launched on Oct. 4, 2019, the Brilliant Future campaign aims to raise awareness and support for UC Irvine. By engaging 75,000 alumni and garnering $2 billion in philanthropic investment, UC Irvine seeks to reach new heights of excellence in student success, health and wellness, research and more. The School of Physical Sciences plays a vital role in the success of the campaign. Learn more by visiting https://brilliantfuture.uci.edu/uci-school-of-physical-sciences.

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