Self-cleaning coating technique prevents fogging

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(Credit: NTU Singapore)

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Researchers at NTU Singapore have developed a new two-stage coating process for plastic surfaces that prevents them fogging up and also aids self-cleaning.

The first stage involves the plastic treated with oxygen plasma in a vacuum, which improves adhesion and prepares the surface for the second stage. Next, the plastic is coated in a thin double-layered silicon dioxide-titanium dioxide film using laser deposition. According to the NTU Singapore team, the new approach offers better control of the film's thickness and structure during fabrication and results in a higher quality film compared with existing methods.

When subjected to abrasion using a cheesecloth pad, a standard test for optical coating, and an adhesion test using cellophane tapes, the coating maintained good durability.

Fogging occurs when water vapour condenses as water droplets on a surface, and so the anti-fogging performance of coatings is measured by the speed at which the condensed water droplets spread into a uniform film that does not block vision. In experiments on the new coating, digital fast frame imaging showed a water droplet spreading within 93 milliseconds. The work is published in *Applied Surface Science* (https://www.sciencedirect.com/science/article/abs/pii/S0169433221033304?via%3Dihub).

Anti-fogging sprays and wipes are popular products among eyeglass wearers, particularly during the COVID-19 pandemic when mask wearers sought to prevent condensation obscuring their view. Anti-fogging coatings are also used in solar panels, windshields and displays or lenses that are used in humid environments.

Researchers elsewhere have developed anti-fogging coatings for plastics but the NTU Singapore team said two of the biggest barriers to their widespread adoption are the long processing time for fabrication and poor durability.

“Our team has demonstrated an approach that is fast to fabricate, taking around an hour, and produces long-lasting results, proving its potential for wide-ranging practical applications,” said co-principal investigator, Professor Chen Zhong of the NTU School of Materials Science and Engineering (MSE).

Titanium dioxide has photocatalytic ability which allows it to self-clean by reacting with and removing organic residues under ultraviolet light exposure. In lab tests of its self-cleaning ability the newly developed coating was able to break down contaminants on the plastic surface after a full day of ultraviolet light exposure.

Co-lead researcher, Professor Rajdeep Singh Rawat, Head, Natural Sciences & Science Education Academic Group at the National Institute of Education, NTU, said: “Our innovation is promising for use in industrial applications of various optical components, for example, on surveillance camera protective covers.

"The ability for the coating to self-clean makes it a low-maintenance and trouble-free solution since the cover may be less obscured by surface dirt and grime, providing a clearer view for surveillance.”

The research team has filed a Singapore patent for the innovation and the team is looking for industrial collaborations to take the innovation to market.
