NEWS RELEASE

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NTU Singapore scientists develop long lasting anti-fogging coating for plastic surfaces that 'self-cleans'

Scientists at **Nanyang Technological University, Singapore (NTU Singapore)** have developed a new type of coating that, when applied on a plastic surface, prevents fogging and 'self-cleans', overcoming the need for frequent reapplications.

The durable coating of a thin double layered silicon dioxide - titanium dioxide film is applied through a two-step technique.

Firstly, the plastic surface is treated with oxygen plasma, which is a common industrial method to clean surfaces to improve adhesion. Then the thin double layered film is deposited on the plastic surface using pulse laser deposition – in which a laser beam is focused to vaporise material from the intended coating targets to achieve the desired level of thickness of the film.

The approach offers better control of the film's thickness and structure during fabrication, compared to similar industrial methods, and results in a higher quality film.

The coating showed excellent adherence to the plastic surface. When subjected to abrasion using a cheese cloth pad – a standard test for optical coating, and an adhesion test using cellophane tapes, the coating maintained good durability.

Fogging is observed when water vapour condenses as water droplets on a surface, and so the anti-fogging performance of coating 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, less than the duration of the average human eye blink of 100 milliseconds.

The findings by the NTU team were published in the peer-reviewed scientific journal *Applied Surface Science*, in December 2021.

Overcomes limitations of temporary anti-fogging coatings

Anti-fogging sprays and wipes are popular products among spectacle or eyeglass wearers, more so since the COVID-19 pandemic as mask wearing becomes the norm and wearers seek 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.

However, current solutions in the market, such as anti-fogging sprays and wipes are temporary as they cannot withstand washing and must be reapplied regularly. In addition, they are prone to surface contamination by dirt or bacteria, which means replacement or maintenance is necessary.

While researchers elsewhere have developed anti-fogging coatings for plastics, two of the biggest barriers to their widespread adoption are the long processing time for fabrication and poor durability – that is, weak adhesion between the plastic surface and the coating.

Co-principal investigator of the study, **Professor Chen Zhong of the NTU School of Materials Science and Engineering (MSE)** said, “Most anti-fogging solutions today are temporary and have limited efficacy. 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.”

As a result of the long-lasting anti-fogging and ‘self-cleaning’ ability of the newly devised coating, the NTU research team believes their innovation offers an attractive, long-term solution to overcome issues of plastic fogging that may also reduce costs and waste.

Coating ‘self-cleans’ under sunlight exposure

Titanium dioxide - a chemical used in the coating developed by the NTU team, has photocatalytic ability, meaning it can ‘self-clean’ by reacting with and removing organic residues under sunlight (ultraviolet light) exposure.

In lab tests, of its ‘self-cleaning’ ability, the newly developed coating was able to break down contaminants (i.e., bacteria, dirt) 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 newly developed coating is also anti-reflective with a superior visible light transmittance of up to 89 per cent on a regular plastic lens, about 5 per cent better than the same lens without a coating. This is particularly useful for use in eyeglasses, as higher visible light transmittance allows for more light to travel through the plastic and reach the eye, allowing greater clarity.

First author of the study **Sun Ye, a PhD student at the School of MSE**, said, "The reported results prove the multifunctionality of our coating. It is antireflective, antifogging, and self-cleaning. Additionally, the fabrication approach is fast and easy to implement with great durability. This makes our innovation unique among other antifogging methods which tend to end up with coatings with limited functions."

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

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Notes to Editor:

Paper titled "Mechanically robust multifunctional antifogging coating on transparent", published in *Applied Surface Science*, 22 December 2021.
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About Nanyang Technological University, Singapore

A research-intensive public university, Nanyang Technological University, Singapore (NTU Singapore) has 33,000 undergraduate and postgraduate students in the Engineering, Business, Science, Humanities, Arts, & Social Sciences, and Graduate colleges. It also has a medical school, the Lee Kong Chian School of Medicine, set up jointly with Imperial College London.

NTU is also home to world-class autonomous institutes – the National Institute of Education, S Rajaratnam School of International Studies, Earth Observatory of

Singapore, and Singapore Centre for Environmental Life Sciences Engineering – and various leading research centres such as the Nanyang Environment & Water Research Institute (NEWRI) and Energy Research Institute @ NTU (ERI@N).

Ranked amongst the world's top universities by QS, NTU has also been named the world's top young university for the past seven years. The University's main campus is frequently listed among the Top 15 most beautiful university campuses in the world, and it has 57 Green Mark-certified (equivalent to LEED-certified) building projects, of which 95% are certified Green Mark Platinum. Apart from its main campus, NTU also has a campus in Singapore's healthcare district.

Under the NTU Smart Campus vision, the University harnesses the power of digital technology and tech-enabled solutions to support better learning and living experiences, the discovery of new knowledge, and the sustainability of resources.

For more information, visit www.ntu.edu.sg

About the National Institute of Education, Singapore

The National Institute of Education, an autonomous institute of Nanyang Technological University (NIE NTU), Singapore, is among the world's top education institutes renowned for its excellence in teacher education and educational research. Founded in 1950, NIE has played a key and pivotal role in shaping and developing Singapore's teaching workforce.

With the vision to be an institute of distinction that leads the future of education in a dynamic milieu, NIE prepares teachers with the requisite values, skills and knowledge to meet the evolving demands of present and future learners. The quality of NIE's programmes is based on evidence-informed reviews and enhancement, and delivered using innovative pedagogies in digitally-mediated learning spaces. There is a keen focus on linking theory to practice and on developing students with a global and inquiring mindset for lifelong learning.

Our degree, higher degree and professional development programmes offer global perspectives through international practical and semester exchanges, while future-ready pedagogies, multidisciplinary curricula and service learning initiatives help us to develop the holistic reflective practitioner and school leader. NIE is ranked among top institutions for research impact and excellence in the field of Education. Our research philosophy is focused on impacting school practices, enhancing programmes, informing policy formation and ultimately, improving student learning outcomes. Our vibrant research culture has seen us ranked consistently among the top in the Bibliometric Indicators of Publications in Education and in the QS World University Rankings for Education as a discipline in recent years.

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