Engineering team develops novel nanofibre solution for clean, fresh air

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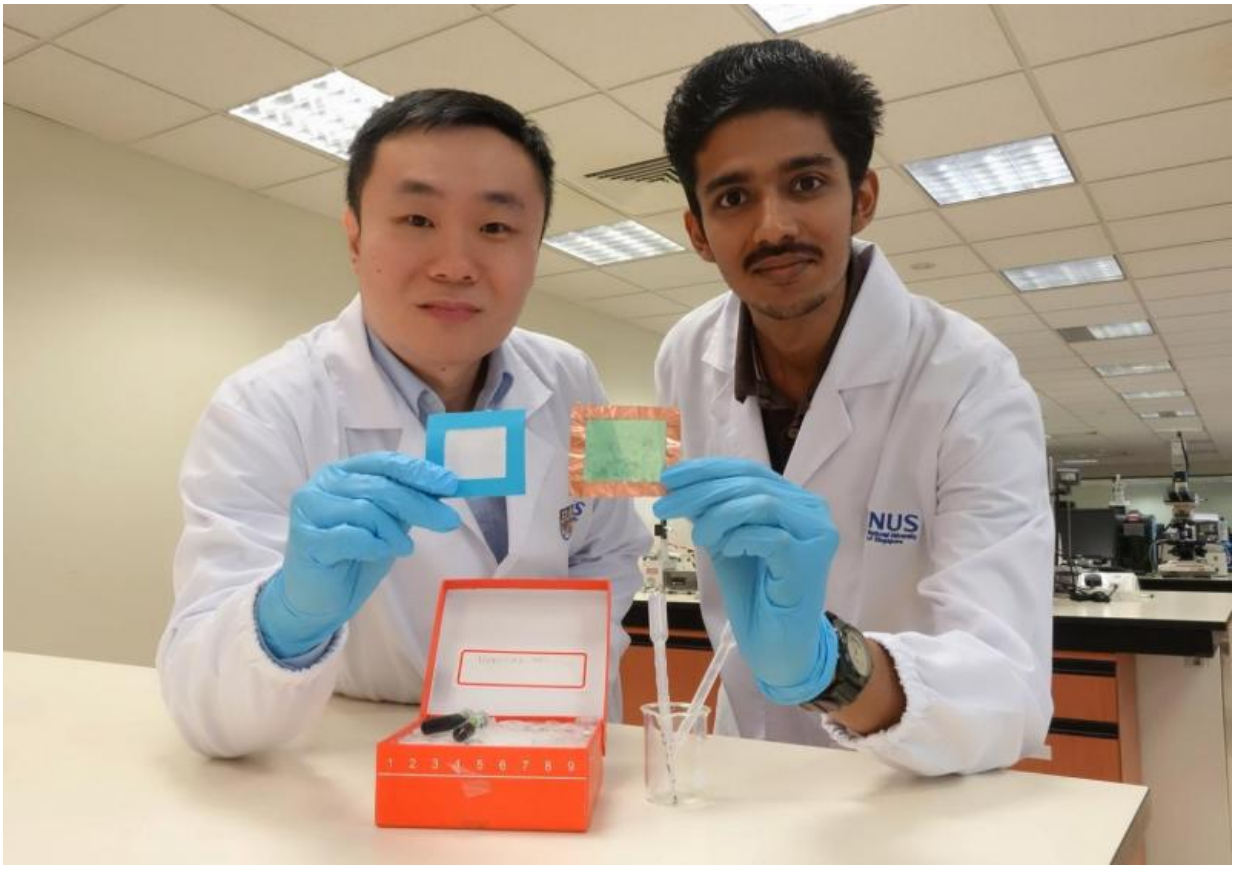

Assistant Professor Tan Swee Ching (left), Mr Sai Kishore Ravi (right) and their team from the National University of Singapore's Faculty of Engineering has developed a novel nanofibre solution that creates thin, see-through air filters (held by Mr Sai) that can remove up to 90 per cent of PM2.5 particles and achieve 2.5 times better air flow than conventional air filters. Credit: National University of Singapore

A research team from the National University of Singapore (NUS) has successfully concocted a novel nanofibre solution that creates thin, see-through air filters that can remove up to 90 per cent of PM2.5 particles and achieve high air flow of 2.5 times better than conventional air filters. As an added bonus, this eco-friendly air filter improves natural lighting and visibility while blocking harmful ultraviolet (UV) rays.

Overall, air filters developed using the novel nanofibre solution are two times better in quality than commercial ones, and are suitable for applications on windows and doors to improve indoor air quality. This novel air filter also has promising applications in respirators.

The NUS team's air filter is also eco-friendly and easy to produce – simply by applying the novel nanofibre solution onto a non-woven mesh, and leaving it to dry naturally. Using phthalocyanine, a chemical compound commonly used in dyeing, the NUS team engineered organic molecules that could self-organise, similar to the stacking of building blocks, to form nanoparticles and subsequently, nanofibres. These nanofibres, which exist in the form of an organic solution, easily "cling" onto the non-woven mesh when dispersed onto the material.

"Air pollution poses serious health threats. Therefore, there is a strong need for economical and effective technologies for air filtration. Currently, most nanofibres used in air filters are energy intensive to produce and require specialised equipment. Our team has developed a simple, quick and cost-effective way of producing high-quality air filters that effectively remove harmful particles and further improves indoor air quality by enhancing air ventilation and reducing harmful UV rays. In the long run, it may even be possible for a DIY (do-it-yourself) kit to be made available commercially for consumers to make air filters at home," explained Assistant Professor Tan Swee Ching from the Department of Materials Science and Engineering at the NUS Faculty of Engineering, who led the research.

The NUS team also comprises Mr Sai Kishore Ravi from the NUS Department of Materials Science and Engineering, and Dr Varun Kumar Singh, who was formerly with the Department. The findings of the study was recently published in the online version of scientific journal, *Small*.

About two times better in quality than commercial respirators

Air-filters are generally gauged by a parameter called quality factor, which is dependent on two sub-factors, namely particle filtration efficiency and air permeability. Currently, while commercial respirators have a high particle filtration efficiency, air permeability is still considerably low, thus resulting in a low quality factor.

The NUS team's novel air filter achieves a quality factor of about two times higher than commercial respirators. It can filter up to 90 per cent of hazardous particles that are less than 2.5 microns in size – also known as PM2.5 particles and associated with serious health threats – while maintaining air flow that is 2.5 times better than these respirators, resulting in better breathability. In fact, the particle filtration efficiency can also be further enhanced, depending on the purpose and functionality of the air filter.

"High-efficiency air filters often requires multiple layers of microfibres or nanofibres, thus limiting their transparency and as such, they are not suitable to be incorporated in doors and windows of buildings. The see-through air filter developed using our approach has promising applications in terms of improving indoor air quality, and could be especially useful for countries experiencing haze or with high pollution levels. While increasing filtration efficiency will lead to a trade-off in air flow, the overall performance of our air filter is still better than commercial respirators," explained Asst Prof Tan.

Next steps

The NUS research team has filed a patent for this novel invention. Moving forward, the team is looking into adding more functionalities, such as anti-bacterial properties, into the air filter. The team is also planning to work with industry partners to commercialise this novel technology.

More information: V. K. Singh, S. K. Ravi, W. Sun, S. C. Tan, *Small* 2017, 13, 1601924.

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