Research team designs silicon spikes that can take out 96% of virus particles

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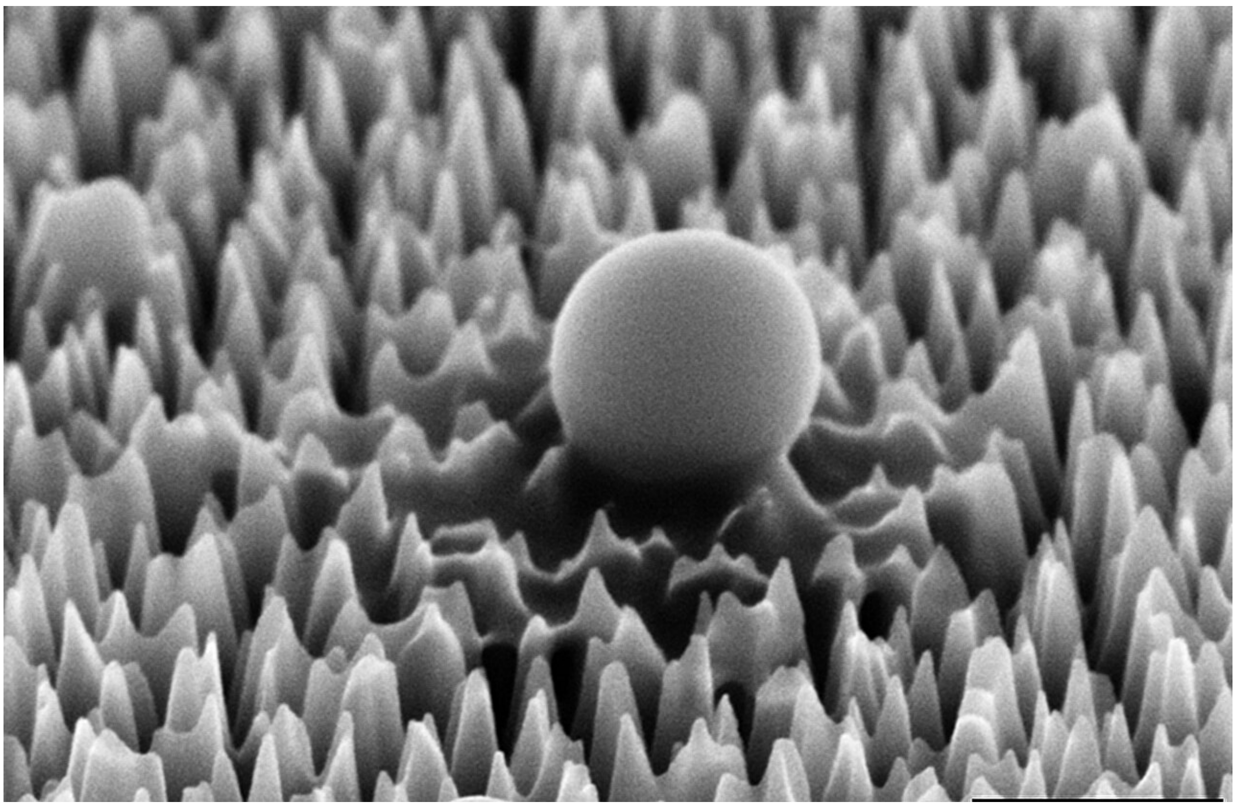


A virus cell on the nano spiked silicon surface, magnified 65,000 times. After 1 hour it has already begun to leak material. Credit: RMIT

An international research team led by RMIT University has designed and manufactured a virus-killing surface that could help control disease spread in hospitals, labs and other high-risk environments.

The surface made of silicon is covered in tiny nanospikes that skewer viruses on contact.

Lab tests with the hPIV-3 virus—which causes bronchitis, pneumonia and croup—showed 96% of the viruses were either ripped apart or damaged to the point where they could no longer replicate to cause infection.

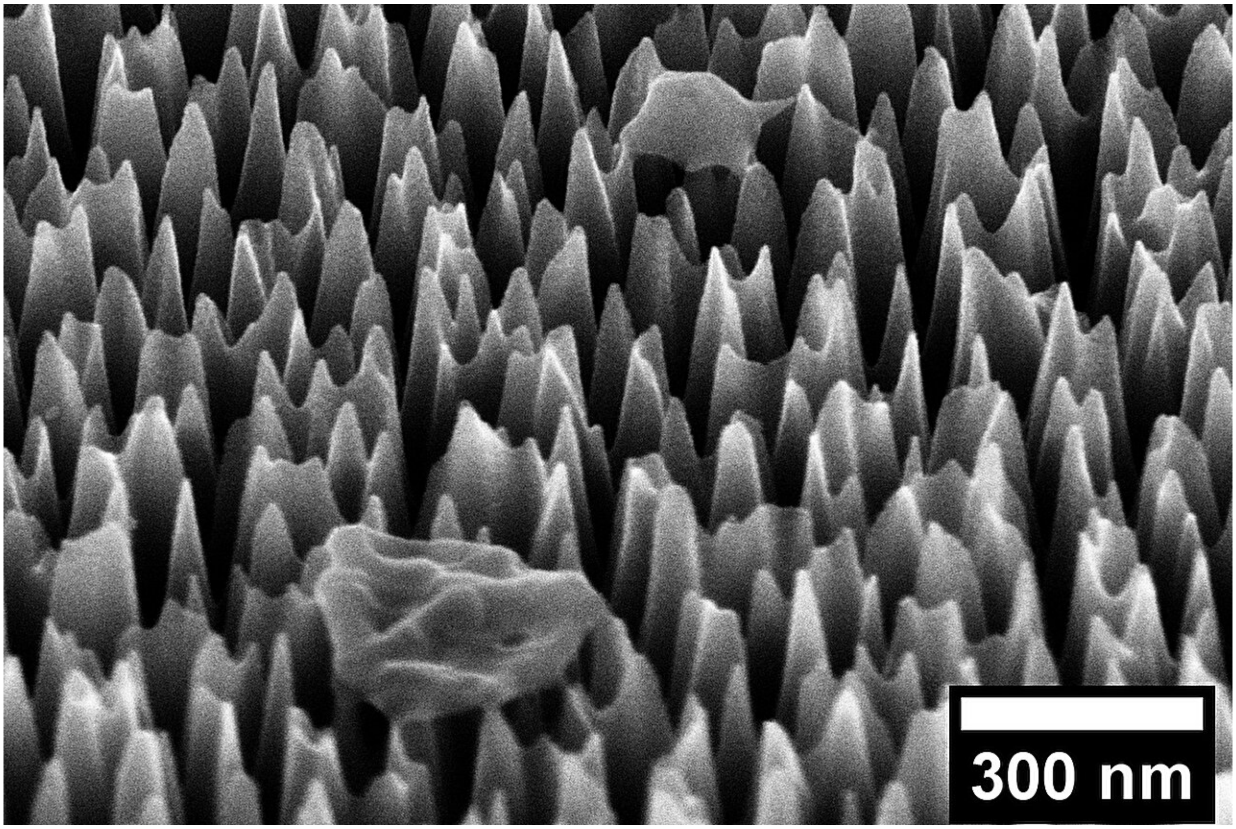
These results, featured on the cover of *ACS Nano*, show the material's promise for helping control the transmission of potentially dangerous biological material in laboratories and health care environments. The paper is titled "Piercing of the Human Parainfluenza Virus by Nanostructured Surfaces."

Spike the viruses to kill them

Corresponding author Dr. Natalie Borg, from RMIT's School of Health and Biomedical Sciences, said this seemingly unsophisticated concept of skewering the virus required considerable technical expertise.

"Our virus-killing surface looks like a flat black mirror to the naked eye but actually has tiny spikes designed specifically to kill viruses," she said.

"This material can be incorporated into commonly touched devices and surfaces to prevent viral spread and reduce the use of disinfectants."



A virus cell on the nano spiked silicon surface, magnified 65,000 times. After 6 hours it has been completely destroyed. Credit: RMIT

The nano spiked surfaces were manufactured at the Melbourne Center for Nanofabrication, starting with a smooth silicon wafer, which is bombarded with ions to strategically remove material.

The result is a surface full of needles that are 2 nanometers thick—30,000 times thinner than a human hair—and 290 nanometers high.

Specialists in antimicrobial surfaces

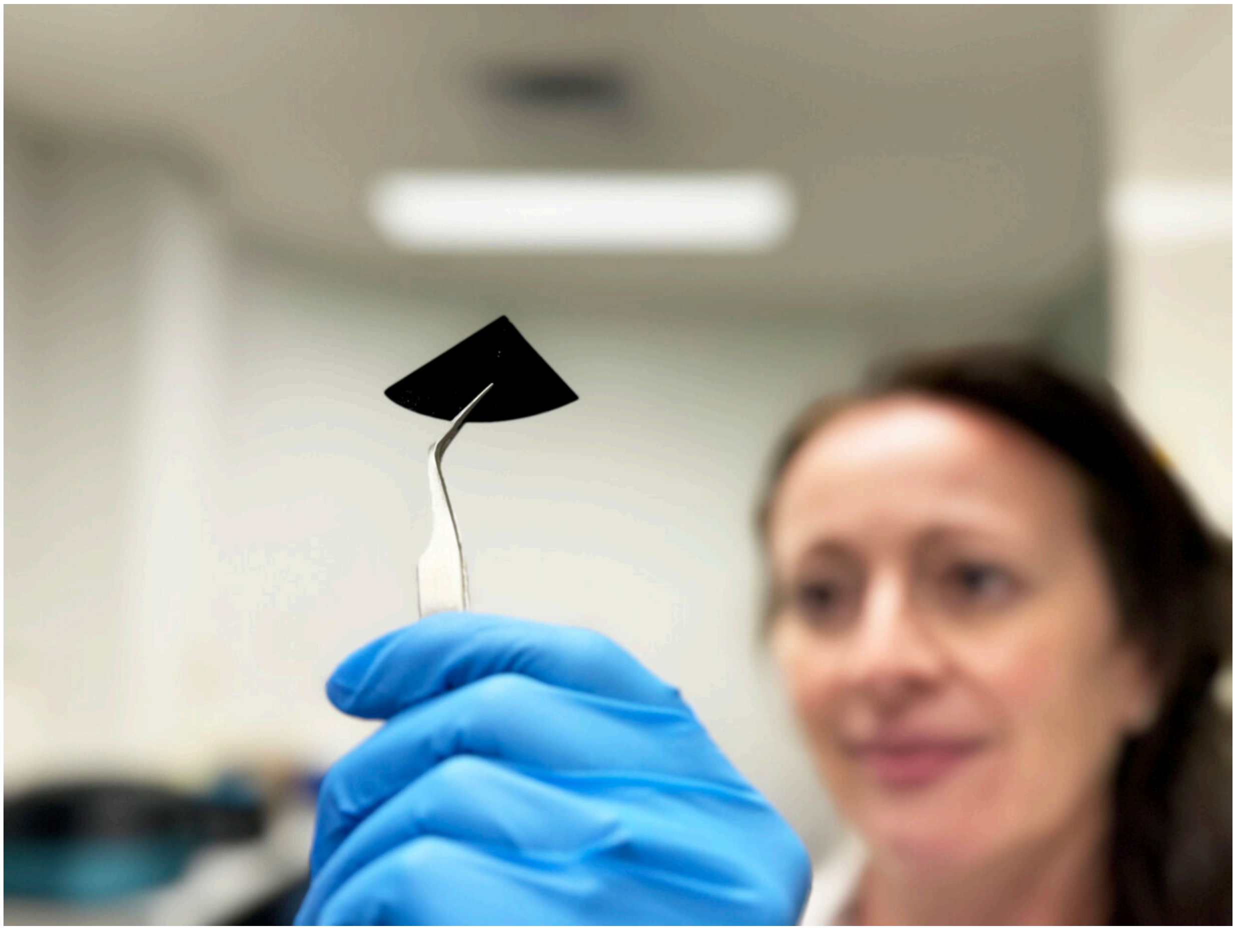
The team led by RMIT Distinguished Professor Elena Ivanova has years of experience studying mechanical methods for controlling pathogenic microorganisms inspired by the world of nature: the wings of insects such as dragonflies or cicadas have a nanoscale spiked structure that can pierce bacteria and fungi.

In this case, however, viruses are an order of magnitude smaller than bacteria so the needles must be correspondingly smaller if they are to have any effect on them.

The process by which viruses lose their infectious ability when they contact the nanostructured surface was analyzed in theoretical and practical terms by the research team.

Researchers at Spain's Universitat Rovira i Virgili (URV), Dr. Vladimir Baulin and Dr. Vassil Tzanov, computer simulated the interactions between the viruses and the needles.

RMIT researchers carried out a practical experimental analysis, exposing the virus to the nanostructured surface and observing the results at RMIT's Microscopy and Microanalysis Facility.



Dr. Natalie Borg inspects a sample of the nano spiked silicon sheet. Credit: RMIT

The findings show the spike design to be extremely effective at damaging the virus' external structure and piercing its membranes, incapacitating 96% of viruses that came into contact with the surface within six hours.

Study first author, Samson Mah, who completed the work under an RMIT-CSIRO Masters by Research Scholarship and has now progressed to working on his Ph.D. research with the team, said he was inspired by the practical potential of the research.

"Implementing this cutting-edge technology in high-risk environments like laboratories or health care facilities, where exposure to hazardous biological materials is a concern, could significantly bolster containment measures against infectious diseases," he said.

"By doing so, we aim to create safer environments for researchers, health care professionals, and patients alike."

The project was an interdisciplinary and multi-institutional collaboration carried out over two years, involving researchers from RMIT, URV (Spain), CSIRO, Swinburne University, Monash University and the Kaiteki Institute (Japan).

More information: Samson W. L. Mah et al, Piercing of the Human Parainfluenza Virus by Nanostructured Surfaces, *ACS Nano* (2023). DOI: 10.1021/acsnano.3c07099

Provided by RMIT University