Study finds silicon, gold and copper among new weapons against COVID-19

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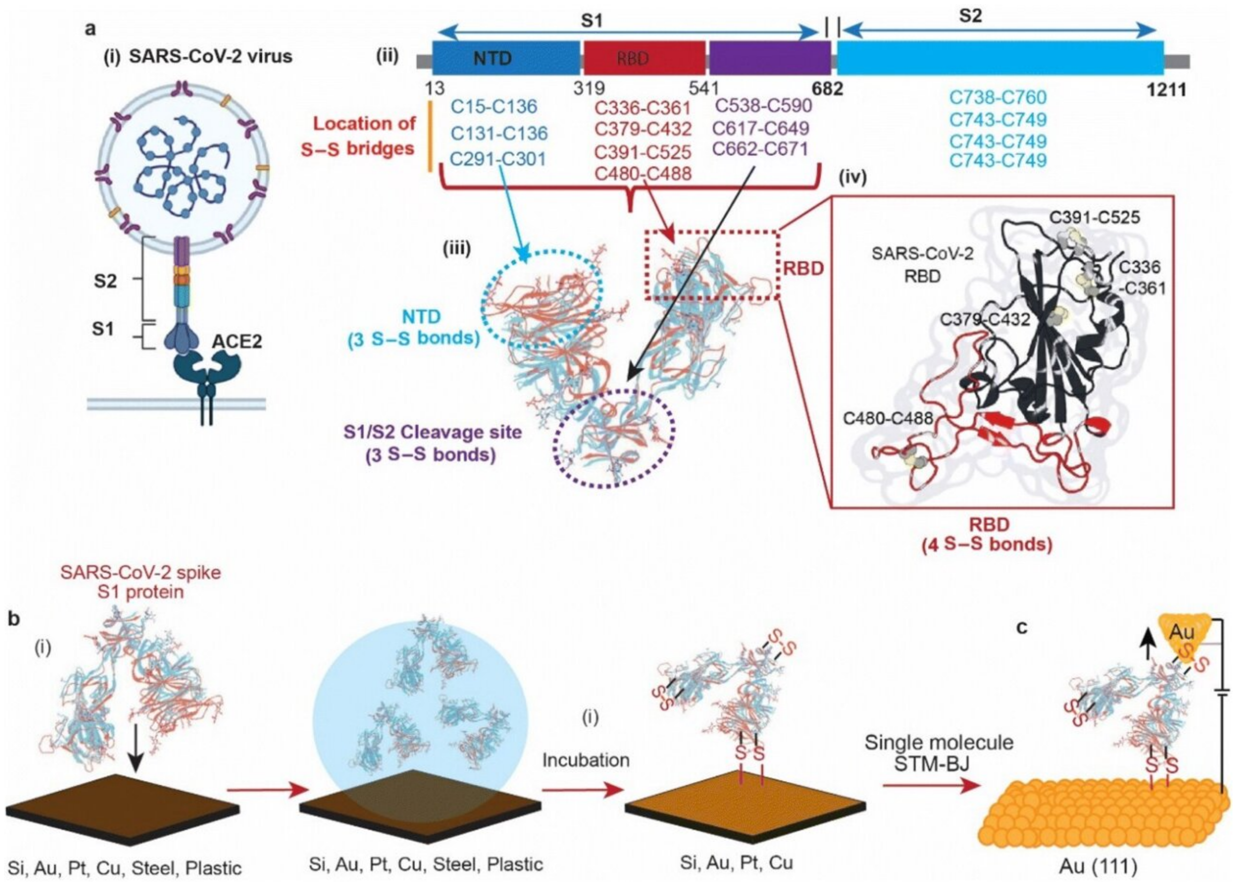

Structural properties of the SARS-CoV-2 spike S1 protein and its interaction with different surfaces. (a) Schematic representation of the SARS-CoV-2 virus (i), its spike protein (S1 + S2) amino acid sequence depicting the positions of the disulfide bridges in each domain (ii), with the structure of the S1 subunit containing 4 disulfide bridges at the RBD, 3 disulfide bridges at the NTD and 3 disulfide bridges at the S1/S2 cleavage site (iii). (b) Schematic describing the interaction of SARS-CoV-2 (2019-nCoV) spike protein with different surfaces.

The surfaces were incubated in the spike protein solution in phosphate buffer saline (PBS), pH 7.4 before further analysis. (c) Schematic showing the wiring of the SAR-CoV-2 spike S1 protein between two gold nano-electrodes in a scanning tunneling microscopy-break junction (STM-BJ) experiment. Credit: *Chemical Science* (2023). DOI: 10.1039/D2SC06492H

New Curtin research has found the spike proteins of SARS-CoV-2, a strain of coronaviruses that caused the COVID-19 pandemic, become trapped when they come into contact with silicon, gold and copper, and that electric fields can be used to destroy the spike proteins, likely killing the virus.

Lead researcher Dr. Nadim Darwish, from the School of Molecular and Life Sciences at Curtin University said the study found the spike proteins of coronaviruses attached and became stuck to certain types of surfaces.

"Coronaviruses have spike proteins on their periphery that allow them to penetrate host cells and cause infection and we have found these proteins becomes stuck to the surface of silicon, gold and copper through a reaction that forms a strong chemical bond," Dr. Darwish said.

"We believe these materials can be used to capture coronaviruses by being used in air filters, as a coating for benches, tables and walls or in the fabric of wipe cloths and face masks."

"By capturing coronaviruses in these ways we would be preventing them from reaching and infecting more people."

Co-author Ph.D. candidate Essam Dief, also from the School of Molecular and Life Sciences at Curtin University said the study also found the coronavirus could be detected and destroyed using electrical pulses.

"We discovered that electric current can pass through the spike protein and because of this, the protein can be electrically detected. In the future, this finding can be translated to involve applying solution to a mouth or nose swab and testing it in a tiny electronic device able to electrically detect the proteins of the virus. This would provide instant, more sensitive and accurate COVID testing," Mr. Dief said.

"Even more exciting, by applying electrical pulses, we found the spike protein's structure is changed and at certain magnitude of the pulses, the protein is destroyed. Therefore, electric fields can potentially deactivate coronaviruses."

"So, by incorporating materials such as copper or silicon in air filters, we can potentially capture and consequently stop the spread of the virus. Also importantly, by incorporating electric fields through air filters for example, we also expect this to deactivate the virus."

"The study is exciting both fundamentally as it enables a better understanding of coronaviruses and from an applied perspective in helping to develop tools to fight the transmission of current and future coronaviruses."

The findings are published in the journal *Chemical Science*.

More information: Essam M. Dief et al, SARS-CoV-2 spike proteins react with Au and Si, are electrically conductive and denature at 3 × 108 $V m^{-1}$: a surface bonding and a single-protein circuit study, *Chemical Science* (2023). DOI: 10.1039/D2SC06492H

Provided by Curtin University