Detecting the fingerprints of harmful molecules noninvasively via black silicon

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Alexander Kuchmizhak in the laboratory, FEFU. Credit: FEFU

Scientists of the Far Eastern Federal University (FEFU) in cooperation with colleagues from the Russian Academy of Sciences (RAS), Australian and Lithuanian Universities have improved the technique of

ultrasensitive nonperturbing spectroscopic identification of molecular fingerprints.

A group of physicists experimentally confirmed that molecular fingerprints of toxic, explosive, polluting and other dangerous substances could be reliably detected and identified by surface-enhanced Raman spectroscopy (SERS) using black silicon (b-Si) substrate. The results of the work are published in the authoritative scientific journal *Nanoscale*.

"When detecting the smallest molecules using SERS spectroscopy their interaction with the nanostructured substrate—the platform allowing ultrasensitive identification—is crucial," the head of research team Alexander Kuchmizhak, Ph.D., reported. Alexander is a researcher of the Department of Theoretical and Nuclear Physics of the School of Natural Sciences of the FEFU. He also added: "Currently noble metals-based substrates are chemically active and as a result, they distort the characteristic molecules signals."

"Due to its special morphology black silicon significantly enhances the signal from the molecules wanted. This nanomaterial doesn't support catalytic conversion of the analyte as it could be in the case of the metal-based substrates applying. The black silicon- based substrate is unique: being absolutely chemically inert and non-invasive it could support a strong and non-distorted signal," says Alexander Kuchmizhak.
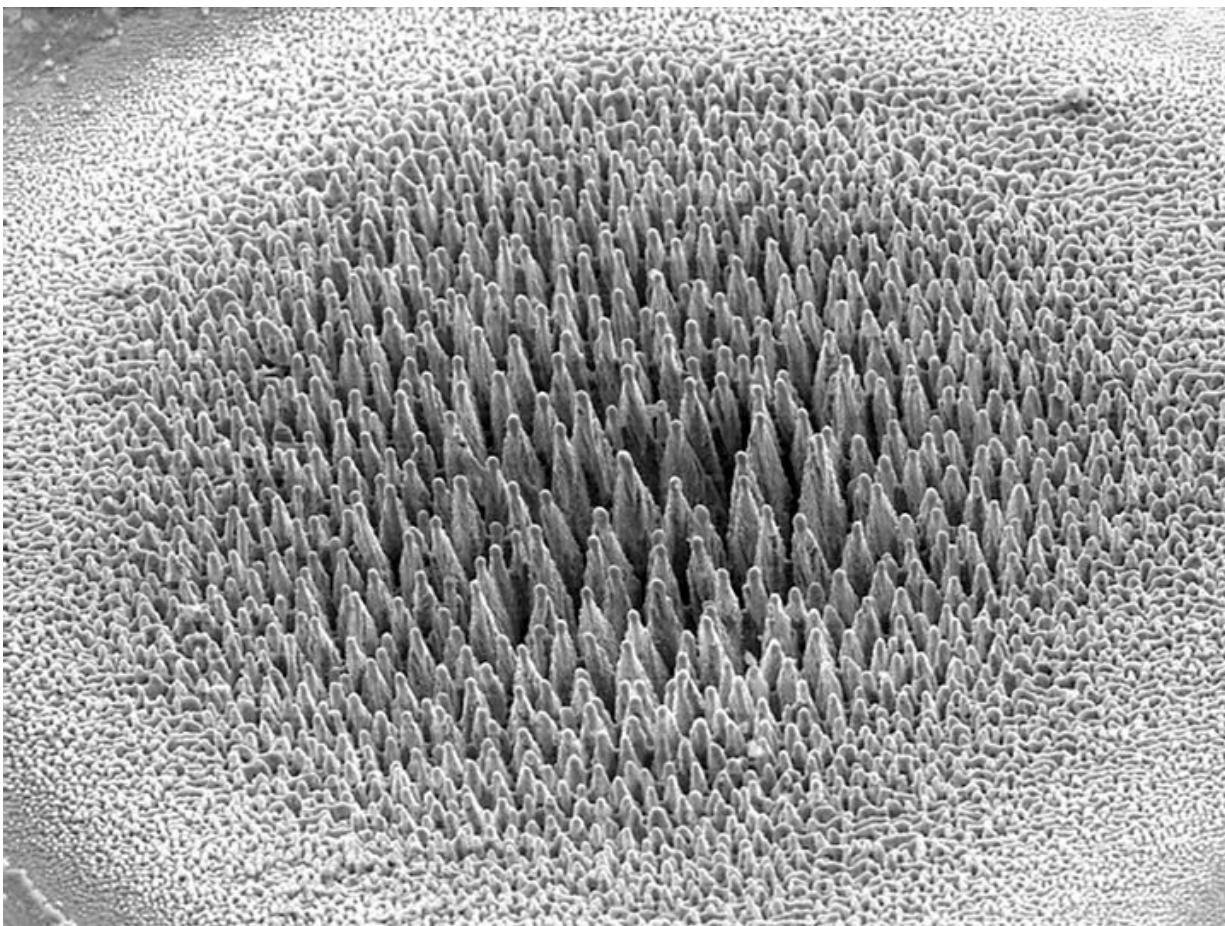
The needle-shaped surface structure of black silicon where needles are made of single-crystal silicon. The nanomaterial is absolutely chemically inert, non-invasive, and could support a strong and non-distorted signal Credit: FEFU

The substrate can be fabricated by using the easy-to-implement scalable technology of plasma etching, thus has good prospects for commercial implementation. Such inexpensive non-metallic substrates with high accuracy of detection can be promising for routine SERS applications, where the non-invasiveness is of high importance.

More information: E. Mitsai et al, Chemically non-perturbing SERS detection of a catalytic reaction with black silicon, *Nanoscale* (2018).

Provided by Far Eastern Federal University

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