Nanopost Arrays Anchor Molecules, Improve Ion Yields for Laser Mass Spectrometry

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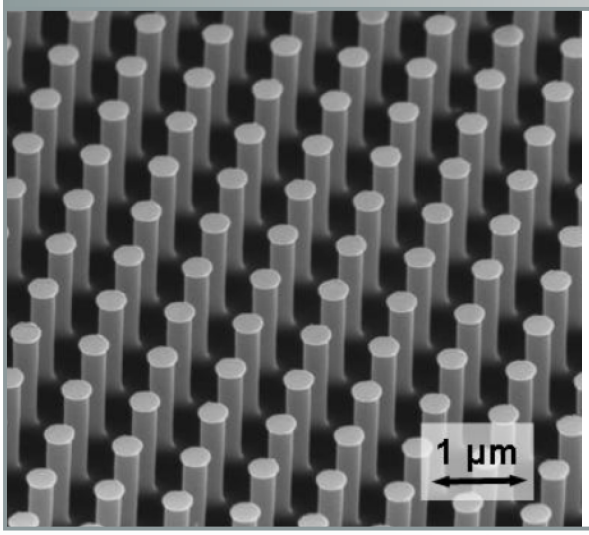

Scanning electron microscope image of a NAPA with a post height of 1000 nm, post diameter of 200 nm, and periodicity of 500 nm

Technology Summary

Silicon nanopost arrays (NAPA) in a broad range of geometries are being developed at ORNL. These can be used as matrices to detect and analyze molecules by laser mass spectrometry: A matrix of nanoposts protects the biomolecule from beam damage and facilitates the vaporization and ionization needed in mass spectrometry. The nanofabricated arrays also provide improved laser ionization yields, so that the molecular samples deposited on them can be detected and identified with great selectivity and sensitivity.

Nanostructured surfaces, particularly with features that have dimensions matching the wavelength of electromagnetic radiation, exhibit unique optical properties via laser mass spectrometry. Biomolecules such as proteins, peptides, and sugars, as well as large organic polymers, dendrimers, and other macromolecules, tend to be fragile and to fragment when ionized by more conventional methods. Ion yields from existing methods exhibit spontaneous fluctuations that can only be controlled by adjusting the energy delivered to the surface.

In the ORNL method, a computer-assisted design generates a nanopost array pattern that is written onto a substrate. The NAPA can be grown to the precise size required. A biological or environmental sample is placed on the array and the array is adapted to work with a pulsed laser with a specific wavelength. Optics based on lenses, mirrors, or a sharpened optical fiber are used to direct the laser radiation at the posts and the target molecules. A mass spectrometer then analyzes and detects ions from the sample that are directly released by the arrays.

Advantages

- Provide improved laser ionization yields and controllable fragmentation with switching capabilities for detection and identification of samples deposited on them
- Can be produced in a wide array of geometries with high accuracy

Potential Applications

- For biological research and monitoring of environmental conditions
- Nanopost arrays with specific geometries are used to anchor and protect proteins, peptides, sugars, polymers, and dendrimers so they can be analyzed selectively and with great sensitivity by laser mass spectrometry

Patent Application

Akos Vertes, Bennett N. Walker, Jessica A. Stolee, and Scott T. Retterer. *Tailored Nanopost Arrays (NAPA) for Laser Desorption Ionization in Mass Spectroscopy*, U.S. Patent Application US 12,755,769, filed April 7, 2010.

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