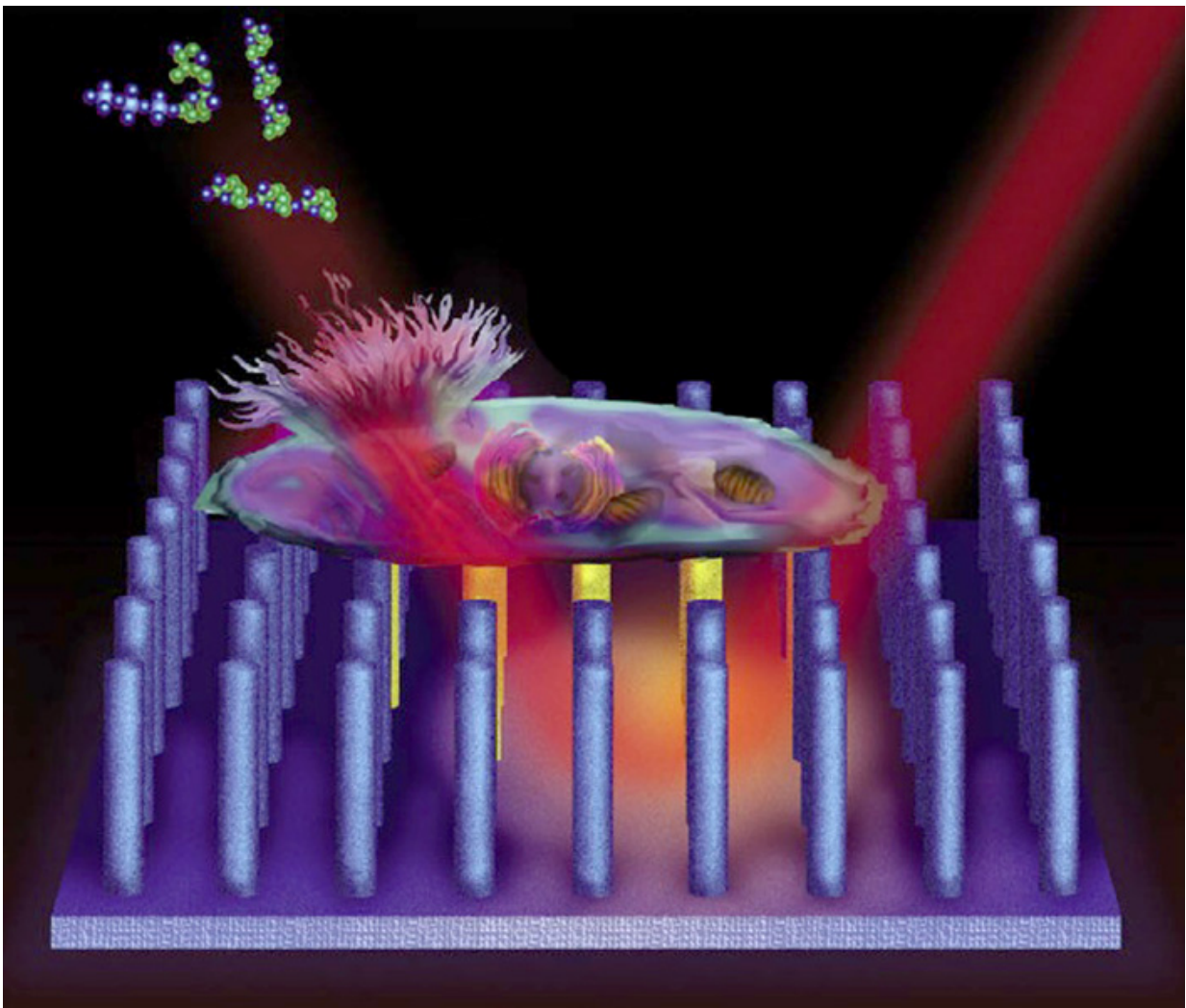


Nanopost array platform reveals metabolic changes in individual cells due to environmental stress

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The matrix-free ionization platform consists of an array of silicon nanoposts. The posts are irradiated by laser pulses that cause ejection and ionization of

molecules from a cell placed on top of the nanopost array. Credit: PCCP Owner Societies

Based on interactions between silicon nanopost arrays (NAPA) and laser light, an ionization platform was developed for the ultrasensitive detection of molecules. With detection limits down to the zeptomolar range (a thousand trillionth of a mole, or about 600 molecules in a sample), this technology can analyze the metabolic composition of individual microbial cells, as well as detect the presence of extremely low levels of contaminants in the environment.

Using the array, scientists can detect and measure trace levels of small [molecules](#) via existing scientific platforms without matrix effects that mask small quantities of molecules. Scientists can use the NAPA to determine changes in cellular metabolite level distributions and metabolic noise upon environmental stress, analyze trace contaminants in liquids, and image molecular distributions in tissues. The NAPA invention was licensed by Protea Biosciences Group, Inc., and commercialized under the REDIchip name in June 2015.

Cells produce and consume varying amounts of metabolites in the course of their regular functioning. To maintain homeostasis or a relatively stable state under changing environmental conditions, cell populations respond by changing the distributions of their metabolite levels. Ideally, investigators would like to observe these responses for a single cell during both stable and stressed states; however, matrix-assisted laser desorption ionization (MALDI) mass spectrometry techniques suffer from matrix-associated background problems that prevent the detection of [small molecules](#) at individual cell levels. Researchers at the George Washington University, working in collaboration with the Center for Nanophase Materials Sciences at the Oak Ridge National Laboratory,

have developed NAPA substrates that can be used for matrix-free mass spectrometry analysis and imaging. The NAPA platform consists of an array of silicon nanoposts that exhibit enhanced electromagnetic fields upon interaction with pulses of laser radiation. This process causes the ionization of cellular molecules without the hassle of a matrix. Using NAPA [mass spectrometry](#), the research group has determined the metabolic response of individual yeast cells to oxidative stress. Additionally, the NAPA platform has shown the capabilities to analyze a wide variety of biomolecules and xenobiotics in a broad class of samples, making it the foundation for matrix-free laser desorption ionization.

Protea Biosciences Group, Inc. exclusively licensed the NAPA platform; in June 2015, the company commercialized the platform under the name of REDIchip.

More information: "Metabolic differences in microbial cell populations revealed by nanophotonic ionization." *Angewandte Chemie International Edition* 52, 3650 (2013). [DOI: 10.1002/anie.201207348](https://doi.org/10.1002/anie.201207348)

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