Fabrication of Nanopipette Arrays for Biosensing

Providing an array of nanopipette channels, formed and controlled in a metal-like material that supports anodization

Nanotechnology focuses on the fabrication of resourceful materials at the nanoscale for application in nanodevices. One such device is a nanopipette biosensor which, through a lock and key approach, can distinguish between various bio-molecules in order to diagnose infectious diseases, cancer and environmental conditions. This technology can be expanded to an array for increased signal, signal redundancy, multiplexing for various biomarkers, and increased device yield. Electrical readout biosensors have gained much attention because, in principle, they can be made more compact than optical technologies. Advances in microfabrication and related technologies helped bring the electrical readout-based biosensor development to the forefront. This invention from NASA permits a multiple channel array of nanopipettes to be fabricated, with some control over channel diameter, channel density, channel length, and other parameters of interest. Presently, the nanochannels must be formed one by one, or in batches with only a few channels per batch.

BENEFITS
- Multiple channel array
- Increased device yield
- Compact
- Sense presence of specified targets or component(s)
THE TECHNOLOGY

This invention provides an array of nanopipette channels, formed and controlled in a metal-like material that supports anodization. The invention also permits selective first and second functionalizations, which may be the same or be different, of first and second channel surfaces so that different reactions of a multi-component fluid flowing in these channels can be evaluated simultaneously. The materials that support anodization include aluminum, magnesium, zinc, titanium, tantalum and niobium, referred to as "AN-metals." The relevant, controllable anodization parameters include applied electrical potential, current density, electrolyte concentration, solution pH, solution temperature and anodization time. The channel parameters that can be controlled include pore diameter, pore density or spacing and maximum channel length of a pore. An anodization process is initially applied to provide a plurality of adjacent nanopipette channels having inner diameters in a selected range, such as 10-50 nanometers (nm). The nanopipette array can sense the presence of a specified component(s), by production of a characteristic signal associated with the functionalized site in the presence of the specified component. Differing concentrations of the same specified component can also be estimated and controlled.

APPLICATIONS

The technology has several potential applications:
- Biomedicine
- Biosensing
- Security
- Environmental sensing
- Infectious disease diagnostics
- Water quality monitoring
- Chemical detection in fluids

PUBLICATIONS

Patent No: 9,182,394

An array of carbon nanofibers as nanoelectrodes