National Aeronautics and Space Administration

Mechanical and Fluid Systems

Wafer Level Microchannel Fabrication Process for Lab-on-a-Chip Devices

Microchannels of 75-m-Diameter Separate Molecular Species

Microchannels fabricated into a silicon-Pyrex wafer with a diameter of 75 m and total channel length of 40, 60, 80, or 100 mm, characterized by specialized microbeads within the channel, have been successfully created, tested, and used at NASA Goddard Space Flight Center. Designed to collect and separate amino acids towards finding the building blocks of life on other planets, this technology could be essential to many other lab-on-a-chip or microfluidic applications.

BENEFITS

- Separates sampled molecules, which can then be analyzed or counted with other tools
- All channel lengths (40, 60, 80, and 100 mm long) fit within a 5- by 10-mm area chip
- A 4-in. wafer could produce 72 microchannel chips
- Specialized microbeads are customizable to the chemistry separation required by the task
- Microposts are customizable for physical molecule separation

technology solution

THE TECHNOLOGY

The microchannel chip is created from a silicon bottom wafer and Pyrex top wafer anodically bonded. Specialized microbeads with specific structure and surface chemistry are placed along the channels. Different species of analyte molecules will interact more strongly with the column chemistry and will therefore take longer to traverse the column, i.e., have a longer retention time. In this way, the channels separate molecular species based on their chemistry.

The specific shape and surface chemistry of these microchannels do more than just move analyte moleculesthe molecules are separated by how they are affected by the channels chemistry for expedited analysis. Paired with mass spectroscopy or ChemFET technology, this technology could enhance research and development in microchemistry, microfluidics, and lab-on-a-chip technology.

Another embodiment of this invention includes microposts inside the microfluidic channel for particle separation, rather than using microbeads. The silicon microposts can be built inside of silicon microfluidic channel by MEMS technology. The size of microposts can vary depending on the application. The microposts function as an in-line filter to block unwanted big particles and protect the microfluidic chip. Furthermore, micropost chips with microvalves can physically select different size cells, molecules, viruses etc. It can also be used to select different particles in bioengineering and pharmaceutical testing.

This figure shows four silicon-Pyrex wafers with 40, 60, 80, and 100 mm length microchannels, respectively.

APPLICATIONS

The technology has several potential applications:

- Lab-on-a-chip technology
- Microfluidics
- Chemical separation
- Chemical detection

PUBLICATIONS

Patent Pending

More Information

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