Enabling Microliquid Chromatography by Microbead Packing of Microchannels

Goddard Space Flight Center, Greenbelt, Maryland

The microbead packing is the critical element required in the success of on-chip microfabrication of critical microfluidic components for in-situ analysis and detection of chiral amino acids. In order for microliquid chromatography to occur, there must be a stationary phase medium within the microchannel that interacts with the analytes present within flowing fluid. The stationary phase media are the microbeads packed by the process discussed in this work. The purpose of the microliquid chromatography is to provide a lightweight, low-volume, and low-power element to separate amino acids and their chiral partners efficiently to understand better the origin of life.

In order to densely pack microbeads into the microchannels, a liquid slurry of microbeads was created. Microbeads were extracted from a commercially available high-performance liquid chromatography column. The silica beads extracted were 5 microns in diameter, and had surface coating of phenyl-hexyl. These microbeads were mixed with a 200-proof ethanol solution to create a microbead slurry with the right viscosity for packing. A microfilter is placed at the outlet via of the microchannel and the slurry is injected, then withdrawn across a filter using modified syringes. After each injection, the channel is flushed with ethanol to enhance packing. This cycle is repeated numerous times to allow for a tightly packed channel of microbeads.

Typical microbead packing occurs in the macroscale into tubes or channels by using highly pressurized systems. Moreover, these channels are typically long and straight without any turns or curves. On the other hand, this method of microbead packing is completed within a microchannel 75 micrometers in diameter. Moreover, the microbead packing is completed into a serpentine type microchannel, such that it maximizes microchannel length within a microchip. Doing so enhances the interactions of the analytes with the microbeads to separate efficiently amino acids and amino acid enantiomers.

This work was done by Manuel Balvin and Yun Zheng of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16514-1