LIGA Fabricated High Aspect Ratio Nickel Gas Chromatograph (GC) Columns as a Step Towards a Portable and Fast GC Instrument

Abhinav Bhushan, Dawit Yemane, Jost Goettert, CAMD, LSU, Baton Rouge, LA
Edward B. Overton, Department of Environmental Studies, LSU, Baton Rouge, LA

A GC-MS analysis is considered as the "gold standard" in scientific analysis. Hence, combining the micro-GC system with a miniature mass spectrometer will lead to a truly portable and fast instrument capable of confirmed testing of compounds. This project involves using a micromachining technique to build high aspect ratio channels to be used as part of a miniaturized GC system. These micro GC columns, built using the LIGA technique, are 30 50 μm wide, 400-650 μm tall (aspect-ratios of 10-15), 0.5-2 m long and cover a spatial area of 1-2 cm2. Integration of some components of the GC system has been achieved on the column chip. Theory suggests that the resolution of the separation is governed by the column width, while the volumetric flow rate and hence the sample carrying capacity depends upon the cross-sectional area of the column. For instance, a 50 μm wide by 600 μm tall rectangular cross-section column will have a flow rate equivalent to a 90 μm diameter circular capillary column, while having the resolution of a 50 μm column. Because of the high thermal conductivity and low heat capacity of nickel, considerably less power is required to heat the columns for temperature programming to more than 350 °C.

Further, LIGA enables efficient integration of such functions as miniature detectors, heaters for temperature programming, and multi-stage pre-concentration directly onto the column chip to form a compact handheld system with enhanced performance in terms of reduced power consumption and increased speed and resolution of analysis. In this poster, the theory involving advantages of high aspect ratio columns will be presented. The challenges in fabricating and coating such columns and preliminary test results will be discussed in detail. Ideas on further integration of necessary components such detectors will also be shared.