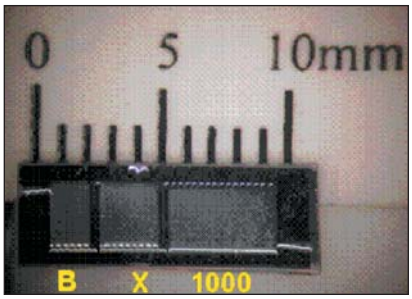
Fundamental Studies Impact the Design and Performance of a Multi-Stage Micro-Preconcentrator



Rebecca A. Veeneman and Edward T. Zellers

Most anticipated applications of microanalytical systems to environmental monitoring require detection of target compounds in the parts-per-billion or parts-per-trillion concentration range. Because detector technologies are not sensitive enough to achieve limits of detection in this range, a preconcentration step is necessary prior to separation and detection. The microfabricated adsorbent preconcentrator/focuser (μPCF) we are developing for the WIMS μGC serves this purpose. This year, we have completed critical characterizations of the μPCF in which fundamental models of vapor adsorption capacity and breakthrough volume were used to correlate material properties and operating parameters to device performance. Adsorption studies of the graphitized-carbon adsorbents used in the device revealed two distinct adsorption-energy regimes that dictate the capacity for vapor adsorption over the relevant concentration range. This behavior has never been observed before and will permit further reductions in the size of the PCF (and power demands) without sacrificing capacity. Through tests of the multi-stage μPCF (shown above) we have characterized the dependence of the adsorption capacity on the volumetric flow rate in the context of classical theory, and we have defined the limits on the allowable flow rates for target vapors of interest. This project exemplifies the application of fundamental science to the design and operation of WIMS microsystems. ■