

Control of flow in Chromatography and Biosensing

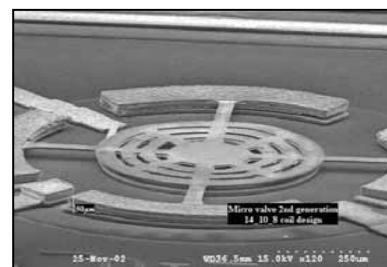
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Goals and Potential Impact if Successful

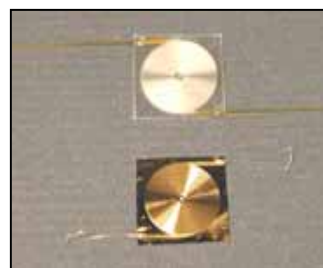
Detection of bio and chemical hazards rapidly in small sample volumes with high selectivity and sensitivity.
Separation of complex mixtures to reduce false positives.
Preconcentration to increase sensitivity of measurement.
GC: Fast acting microvalve for sample injection.
Multiple analyte separation with different column temperatures, column coatings, and flow rates.
Bioassay: Arrays of parallel assays are necessary to increase statistics and carry out positive and negative controls.
Integration of the fluidics with sensors and flow control in aqueous buffer is required. Surface biocompatibility is required and sterilizability may be important for clinical samples.

Approach and/or Accomplishments

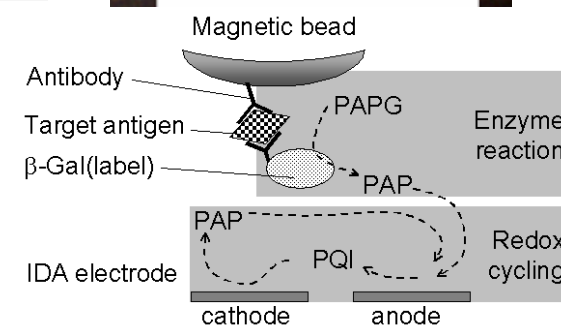
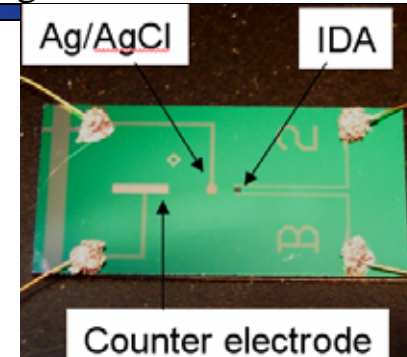
GC: Latching miniature electromagnetic valve demonstrated with actuation current of 0.4A, 2V and a response in under 0.1ms. Operates in air or water/methanol solutions. The pressure drop is $\ll 1$ kPa at 1 ml/min flow and provide low leakage for 24 hours at 57kPa pressure.
MicroGC with low thermal mass, rapid response, and commercial flame ionization detector demonstrated.
Bioassay: Sandwich assay demonstration with magnetic beads (2.8 μ m dia.) in a fluid channel. Detection of 70 amole of β -galactosidase (enzyme label on secondary Ab) and 90ng/ml of MS2 bacteriophage.



Miniature latching microvalve



1m parylene GC column



Bottlenecks and Open Research Questions

1. Pre-concentration of sample.
2. Sample injection with minimal dispersion.
3. Microvalve dynamic characteristics.
4. Uniform coating of the column with different stationary phases, and characterization of coating uniformity.
5. Ultimate sensitivity of assay with magnetic beads.
6. Control of sample volume, fluid flow velocity, magnetic bead location, sample mixing and incubation in a highly parallel format assays.