The Lab-on-Valve: A New Promising Tool for Flow Injection Analysis

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Most instrumental assays are based on bringing the sample to the detector, although the optimal option is to do it the other way round, that is, to bring the detector to the sample – not the least as it allows microminiaturization of the sample processing path. While several flow injection and sequential injection procedures have made it possible to meet this goal, it has, however, been most successfully accomplished in the recently developed Lab-on-Valve (LOV) concept. Originally suggested by Jarda Ruzicka in 2000 (Analyst, 2000, **125**, 1053-1060), the LOV essentially consists of a selector valve on top of which is placed an integrated microconduit. This microconduit is designed to incorporate and facilitate all the necessary operations comprising an assay protocol, that is, mixing of analyte with reagent(s), appropriate column reactors packed for instance with immobilized enzymes or ion-exchangers, or even optical detection devices (such as UV/VIS or fluorescence) communicated by optical fibres. In fact, this device may comprise an entire laboratory facility - hence the name Lab-on-Valve. Moreover, the LOV approach allows novel and unique manipulations to be made, such as exploiting the use of renewable column reactors packed with ion-exchange materials for separation and preconcentration of analytes, the minute amounts of beads used per assay making it most economical. Or loading the LOV with beads furnished with appropriate functional groups for implementing immunoassays, where the bead renewal allows to dispose of any irreversible antigen-antibody bindings, and advantage hence can be taken of using fresh non contaminated beads for a new assay – rather than regenerating them. The LOV- bead injection technique is also finding its way into Analytical Biology. Thus, live pancreatic cells, grown on bead surfaces, have been perfused by glucose in LOV allowing the lactate production and glucose consumption by cells to be monitored in real time by UV-VIS spectroscopy. While most frequently used as a "front end" to UV-VIS spectroscopy, LOV has proven itself as a sublime front end to capillary electrophoresis, allowing appropriate pretreatment of the sample before introduction into the capillary. Most recently, Electrospray Mass Spectrometry has been enhanced by using LOV as a sample pretreatment tool, where a group of biotinilated molecules was separated from serum samples by capturing them on avidine coated beads and subsequent elution into ES-MS. In our laboratory determination of low levels of metal ions in complex matrices has been automated using LOV as a front end to ET-AAS and ICP-MS. This novel approach exploited bead injection – renewable microcolumn to fluidically manipulate Sepahdex microbeads, furnished with ion-exchange functional groups for matrix removal and metal ion capture. The bead were not only automatically metered, packed and eluted and the eluate passed to the ET-AAS, but a procedure for transferring the loaded beads directly into the graphite tube for pyrolization and atomization was also accomplished.

Over the past decade there has been much attention paid to the development and applicability of μTAS systems, and most recently advances in nanotechnology have been progressively more highlighted. Personally, I am sceptical as to the practicality of these concept - μTAS systems have been discussed for years, yet precious few real life applications have actually appeared. And when it comes to the nanotechnology it is, when viewed as to its analytical chemical potentials, still very much in its infancy. Of course, it is to be hoped that both of these concepts might develop, yet we should bear in mind that we normally are faced with analysing practical samples, which mostly, unfortunately, not are ultrapure, and in many instances might contain particles and insoluble matter. In contrast, I am optimistic as to the applicability of the LOV – not the least because I have used it and enjoyed doing so. Several papers describing the use of this novel tool have been published in recent years, and I am convinced that many more, detailing novel and unique applications, will follow. Therefore I do not hesitate to say: LOV is here to stay.