



Flow Analysis on Paper

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Since its introduction in analytical practice almost 40 years ago by Ruzicka and Hansen, Flow Injection Analysis has made significant advances in automation, miniaturization and in the variety and sophistication of the analyses that can be performed. There has been a natural progression from benchtop flow injection analyzers with strip chart recorders, through computer controlled sequential injection (SI) and bead injection analyzers to lab-on-valve, lab-on-chip and μ SI analyzers [1]. This remarkable technological evolution has not always been accompanied by reductions in the cost of the corresponding equipment.

An exciting new development in micro flow analysis involves the use of paper-based microfluidic sensors. These sensors meet the increasing needs of rapid, accurate and low-cost environmental, industrial and clinical, monitoring and analysis. They utilize the capabilities of the cellulose fibres in paper, which form a hydrophilic porous matrix, to transport liquids by capillary force only. There is no need for micro-pumps, which not only simplifies the devices but also drastically reduces their production costs. By selectively hydrophobizing paper it is possible to form liquid penetration channels and detection

zones, where an analytical reaction takes place [2]. In most cases colour reactions are used and the intensity of the detection zone colour can be visually compared to colour charts to assess the approximate analyte concentration. More accurate colour density measurements can be conducted by scanning the paper-based device and determining the colour density value with suitable software. The possibility of printing the cellulose reactive hydrophobization agents on paper using conventional ink-jet printers would allow mass production of these devices at a very low cost.

It can be expected that printable paper-based microfluidics will play an important role in the future development of flow analysis and will be crucial in establishing it as a successful 21st century analytical technique.

References

- [1] J Ruzicka, *From Beaker to Programmable Microfluidics* in SD Kolev and ID McKelvie (Eds) *Advances in Flow Injection Analysis and Related Techniques*, Elsevier (2008).
- [2] X Li, JF Tian, G Garnier, W She, *Colloids Surf B Biointerfaces* 76 (2010) 564.