

From Micro-Fluidic Valves to Polymer Cargo Boats Using Novel Functional Materials Based on Ionic Liquids

Fernando Benito-Lopez, Robert Byrne and Dermot Diamond

CLARITY: Centre for Sensor Web Technologies, National Centre for Sensor Research, Dublin City University, Dublin 9, IRELAND

In this contribution we present recent results obtained with novel stimulus-responsive materials based on ionic liquids. Our results suggest that these materials offer unique capabilities hitherto inaccessible using conventional materials. In particular, we will focus on photo-actuation, magnetic-actuation and solvent driven motion of small structures as examples of the fascinating behaviour of these exceptional materials and their implications in flow control in microfluidic devices.

Polymers which contain spiropyran moieties exhibit photo-actuation behaviour due to changes in overall charge and solvent uptake/release that accompany switching. The actuation behaviour can be enhanced by using an ionic liquid medium to produce hybrid materials called ionogels. We have integrated these hybrid materials into microfluidic valve structures, and demonstrated very effective photonic control of liquid flow using low-power, low-cost LEDs [1].

Moreover, magnetic ionic liquids can be photo-polymerised within different polymeric structures for the generation of novel ionogels which retain their magnetic properties and that can be used to control flow and for moving objects in microfluidic structures in a control manner.

Finally, a surprising degree of movement has been demonstrated using photo-lithographically structured ionogels. The gels were soaked in ethanol and then transferred to water, where they moved spontaneously through expulsion of the ethanol from the ionogel [2].

- [1] F. Benito-Lopez, R. Byrne, A. M. Raduta, N. E. Vrana, G. McGuinness, D. Diamond, *Lab Chip* **2010**, *10*, 195-201.
- [2] R. Byrne, F. Benito-Lopez, S. Scaramagnani, M. Higgins, G. G. Wallace, D. Diamond, In Proceedings of the 9th Nanotechnology Conference: IEEE NANO 2009, Genoa, Italy, July 26-30, 2009, 166-170.