Materials Science: The Key to Revolutionary Breakthroughs in Micro-fluidic Devices

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Nowadays, precise flow control, provision of exact reagent amounts, contamination prevention between reagents, autonomy, disposability and low-cost manufacture are factors that can not be found together for micro-fluidic valves.

Valves made using photo-responsive materials are of great interest as functional materials within micro-fluidic systems since actuation can be controlled by simple light irradiation, without physical contact, offering improvements in versatility during manifold fabrication, and control of actuation. Nevertheless, their poor versatility, slow response times and limited robustness render them currently as scientific curiosities rather than ideally functioning devices.[1]

The incorporation of photo-responsive gels with ionic liquids (ILs) produces hybrid ionogels with many advantages over conventional materials. For example, through the tailoring of chemical and physical properties of ILs, robustness, acid/ base character, viscosity and other critical operational characteristics can be finely adjusted. Therefore, the characteristics of the ionogels can be tuned by simply changing the IL and so the actuation behaviour of micro-valves made from these novel materials can be more closely controlled.[2]

We have investigated the potential use of spiropyran-modified ionogels for controlling fluid within micro-fluidic channels. This remote ability could greatly simplify specific device design and cost. We have effectively incorporated ionic liquids into hydrogels to attain specific material contraction performance.[3] An advantage of using ionic liquids is the plethora of synthetic and material design options that can be used to design devices optimized for certain performance parameters or behaviours.

[1] F. Benito-Lopez, et al.,*Mater.Today*,13,7-8,**2010**,26-33
[2] R. Byrne, et al.,*Biosens.Bioelectron.26*,**2010**,1392-1398
[3] F. Benito-Lopez, et al.,*LabChip*,10,*2*,**2009**,195-201