Electronic Supplementary Material (ESI) for Soft Matter

Role of pH gradients in the actuation of electro-responsive polyelectrolyte gels

P.J. Glazer[a,b], M. van Erp[a], A. Embrechts[a], S.G. Lemay[b,c], E. Mendes[a]

Chemical Engineering[a] & Bionanoscience[b], Delft University of Technology, The Netherlands
MESA+ Institute for Nanotechnology[c], University of Twente, The Netherlands

Supporting information

Swelling and shrinking kinetics of responsive polyelectrolyte gel. During preparation, the gel reaches swelling equilibrium with demineralised and deionised water. Actuation experiments, however, are carried out in salt solutions. To see on what time scale this factor influences sample volume, we measured weight reduction of an actuating gel when moved from the pure water solution in which it was equilibrated to 0.1 M KCl, as illustrated in Fig. S1. The duration of the diffusion-driven de-swelling kinetics is in this case measured in hours, significantly longer than the time needed for actuation.

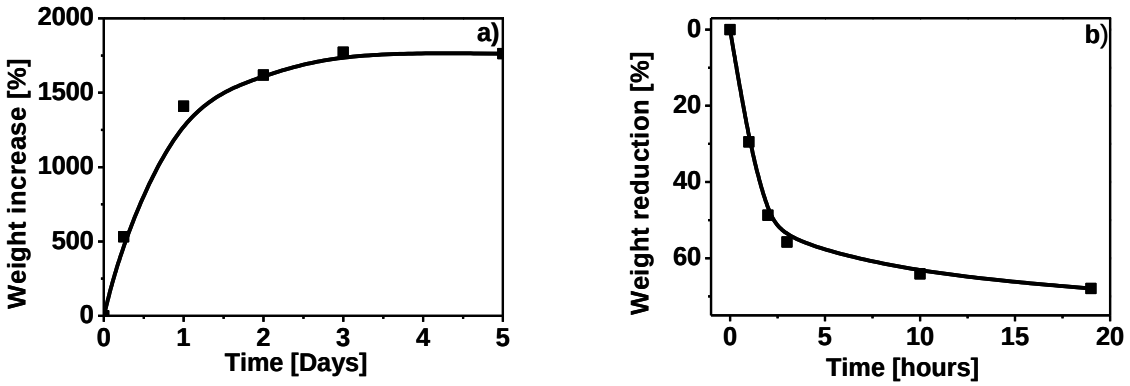

Fig. S1. A) The weight increase of hydrolyzed gel, when originally swelling in pure water; B) Swollen gel sample shrinkage over time following transfer to a 0.1 M KCl solution (no electric field). Solid lines are guides to the eye.

Influence of pH indicator on ionic transport. To investigate whether adding pH indicator influences the properties of the system, we checked how adding 7 ml of pH indicator changes the magnitude of the current measured during actuation. As seen in Fig. S2, the pH indicator has essentially no effect.

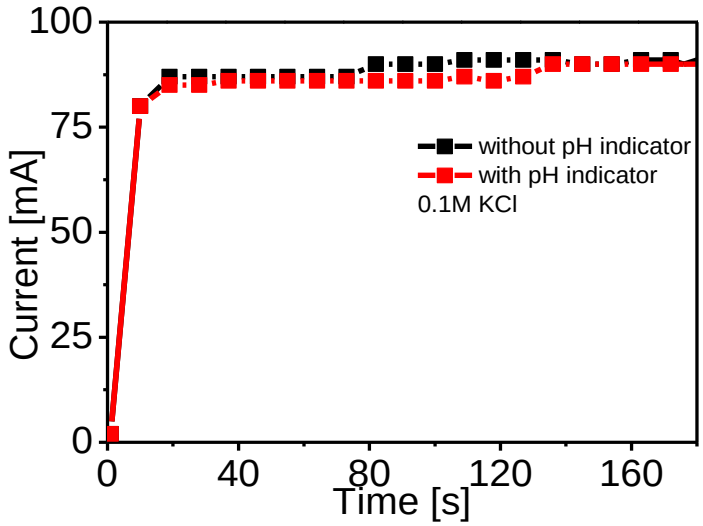

Fig. S2. Power supply current output without and with 7 mL of pH indicator added to 300 ml of 0.1 M KCl solution (1:43 ratio).

Gels prepared in pH indicator. Below are images of non-responsive (Fig. S3) and responsive (Fig. S4) gels incubated in pH indicator and placed in the middle of the electrophoretic unit. The electrophoresis tank is filled with the 0.1 M KCl solution to which pH indicator was added (1:43 ratio).

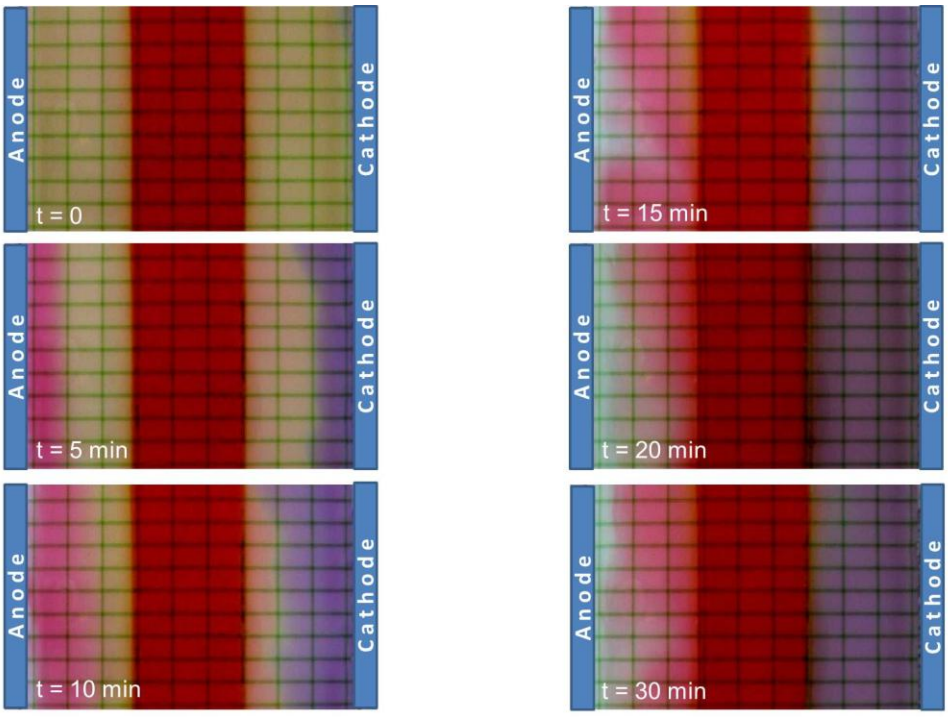

Fig. S3. Response of a non-responsive gel incubated with pH indicator (orange, located in the center of each image). No actuation is observed.

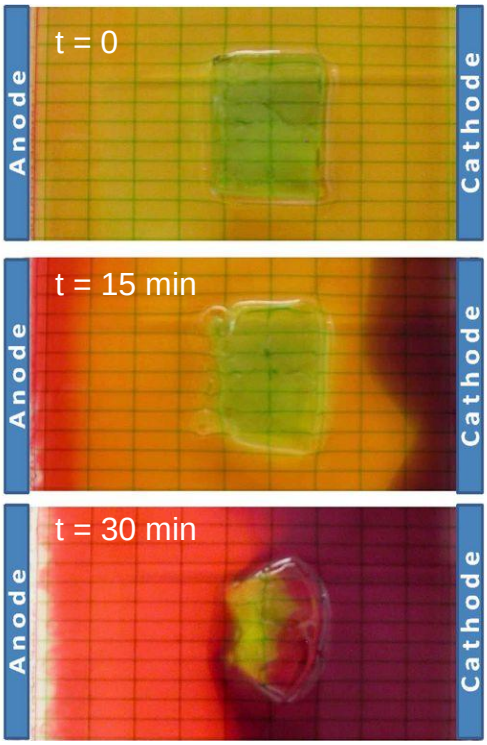

Fig.S4 Actuation of a responsive gel swollen in pH indicator. The response is essentially unchanged from that observed for a gel swollen in pure water.