Electroactive Polymer As Chemomechanical Actuator For Artificial Muscles

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Polymer actuators that are chemically stimulated can be used to mimic biological muscles. Electroactive polymer materials that produce high-actuation displacement have earned the name "artificial muscles" [1]. Chemical actuation has been demonstrated in porous, asymmetric polyaniline membranes [2].This paper details the design of a chemomechanical actuator based on polyaniline. In this study, thin, porous composite films of an electroactive polymer (polyaniline) and cellulose acetate were fabricated by solution casting a precursor solution containing 12 w/v% of polyaniline and 12 w/v% of cellulose acetate in acetone. Thin strips (25mm x 4mm) were constructed from the polymer composite films and were exposed to organic vapors such as acetone and ethanol. This resulted in a change in the conformational structure of the conducting polymer yielding displacement of the composite film upon adsorption of the vapor and restoration to initial state upon desorption. Figure 1 shows the bending-recovery behavior of the composite film on exposure to acetone. The bending-recovery behaviour of the films in different solvents was measured as a function of the bending angle and response time. Morphological characterization of the films correlates the actuating behavior of the composites to the porosity and thickness of the film. The properties of the composite films can be fine tuned to tailor the actuation behaviour to successfully mimic artificial muscles.

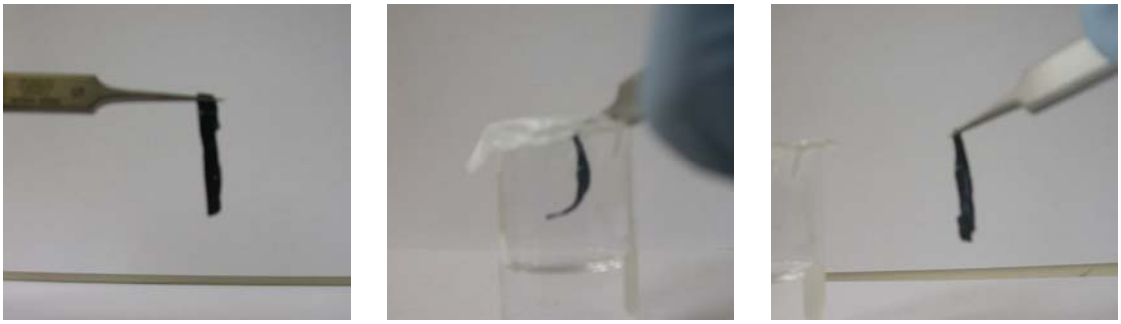

Fig. 1. Optical images of bending-recovery behaviour (a) original shape (b) bending in acetone vapor (c) recovery in air

References:

[1] Bar-Cohen Y, Expert Rev. Med. Devices 2(6), 731-740, 2005. Current and future developments in artificial muscles using electroactive polymers.
[2] Gao JB, Sansinena JM, Wang HL, Chemistry of materials, 2411-2418, Jun 17 2003. Tunable polyaniline chemical actuators.