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Study the effects of polymerization conditions on the force measurements on polypyrrole based artificial muscles

Conducting polymers can be easily synthesized as films by electrochemical oxidation of the corresponding monomer. These films can be electrochemically oxidized and reduced in a continuous, reversible way resulting conformational changes along the polymeric chains. Artificial muscles linked to these reversible conformational changes were developed by constructing conducting polymer/non-conducting polymer bilayers. Aim of this work is to study the influence of the polymerization current density and anion incorporated during the electropolymerization of the conducting polymer polypyrrole (PPy) on the force variation of bilayer "artificial muscles". Fabrication of muscles was done on a polyimide film which was coated with gold layer. Polymerization was done electrochemically. PPy films were prepared with different current densities from 0.1 to 2 mA cm-2. Force measurement set up consists of a microbalance and an electrochemical cell. Force measurements were done by cycling at different sweep rates from 0.5 to 50 mVs-1. In addition force measurements were carried out on PPy benders prepared with small, medium, polymeric and large surfactant anions. Results shows that benders prepared with higher current density films give higher forces compared to the benders fabricated with the films made using lower current densities which can be explained by considering the change in the film formation with different current densities. PPy benders made with different anions clearly showed that the measured force with small

inorganic anions is very small. In addition, the force measured with the polymeric anions is lower than that measured with the medium sized anion. The benders made with surfactant anions gave higher forces. It is believed that these large anions are trapped inside the polymer structure and will not participate in the redox process. It has been observed that the cation movement makes large volume changes in PPy films. In addition, cations carry huge amount of solvent with them. So the force measured should be higher.