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A study on force measurements of conducting polymer artificial muscles

Conducting polymers (CP) such as polypyrrole (PPy) can be easily synthesized by electrochemical oxidation of the monomer. During synthesis, they tend to from free-standing and mechanically-cohesive films. They can be electrochemically oxidized and reduced in a continuous, reversible way. These processes accompany the movement of ions and solvents in side and outside the films.

This result in conformation changes along the polymeric chain. Artificial muscles, which are linked to the conformational changes, were developed by constructing CP/ non-conducting polymer bilayers. There was no systematic study reported on the force,

which can be obtained from these muscles. In this study, investigations have been carried out to measure the force by changing the incorporated anions, sample thickness and the polymerization current density.

Bilayer sritificial muacles were made with PPy on a non-conducting polymer coated with a thin gold layer. Force measurements were carried out with a Quartz Crystal Micro-balance (QCM) and were recorded simultaneously with the cyclic voltammogramms. Muscles made with large surfactant anions gave higher forces than that smaller anions.

The force variation was liner with the sample thickness. The films made with large current densities gave higher forces. There was an increment in the force with the increasing sweep rates. QUM studies verified that large forces can be obtained when cations are the moving species.