A STUDY ON POLYPYRROLE / DODECYL BENZENE SULPHONATE (PPY/DBS) BASED ACTUATORS

A PROJECT REPORT PRESENTED BY

DILUPAMA AYESHANI DIVARATNE

to the Board of Study in Physics of the
POSTGRADUATE INSTITUTE OF SCIENCE

in partial fulfillment of the requirement
for the award of the degree of

MASTER OF SCIENCE IN PHYSICS OF MATERIALS

of the

UNIVERSITY OF PERADENIYA
SRI LANKA
2006

A STUDY ON POLYPYRROLE / DODECYL BENZENE SULPHONATE (PPY/DBS) BASED ACTUATORS

D. A. Divaratne
Department of Physics
University of Peradeniya
Peradeniya
Sri Lanka

Conducting polymers (CPs) that expand and shrink on doping and dedoping with counter ions respectively can be used as actuators. Polymer actuators based on conducting polymers utilize mass transport of ions and accompanied solvent molecules into and out of the polymer.

In this study metal coils and gold plated plastic strips coated with polypyrrole/dodecyl benzene sulphonate (PPy/DBS) conducting polymer films were used as two different types of actuators. Major part of this study was concentrated on finding suitable material for the coil and the conditions needed to optimize the performance of actuators fabricated with selected metal coil. Tungsten, NiCr and stainless steel were used as base metal to form coils. By comparing the strains obtained on cycling the actuators made with different metals in aqueous NaCl electrolytes with various weights attached, it was concluded that tungsten was suitable for better performance. The weight that can be lifted by the actuators was found to depend on the thickness of the polymer film. When the film thickness had a moderate value (~ 0.25 mm) the strain during reduction and as well as during oxidation was comparatively higher than when the thickness was very law (~0.03 mm) and very high (~1.03 mm). The actuator formed by combining eight coils in parallel could lift a weight of 4.3286 g whereas a single coil composite could lift only 0.0422 g. So by combining the single coil composites in parallel to obtain an actuator with a bunch of coils can be used to achieve better performances. The investigation with PPy/DBS coated strip actuators showed that the amount of bending can be improved by adding a Poly(3,4-ethelenedioxythiophene)/dodecyl benzene sulphonate (PEDOT/DBS) layer on top of PPy layer. These investigations also showed that the bending in air is much smaller than that observed in an aqueous electrolyte under same applied voltages.