Versatile Actuators with Linear/Bending Movements in Air using a Series of Polypyrrole and Solid Polymer Electrolyte Trilayers

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ABSTRACT

Actuators that produce linear elongation-contraction or bending are required for various applications. This reported study involved the construction of a versatile electromechanical actuator that is capable to work in air and can be controlled to bend and/or induce linear movement. The challenge is to optimize the combinations of increasing number of Polypyrrole//Solid Polymer Electrolyte//Polypyrrole [PPy//(SPE)//PPy] trilayers to obtain both bending and linear elongation-contraction movements in a single actuator.

An increasing number of [PPy//(SPE)//PPy] trilayers were combined in series to obtain the actuator configuration that is capable of inducing displacements in both bending and linear contraction/expansion movements. A bending displacement was achieved when all trilayers were connected at the same polarity (Figure 1c) while a linear contraction/expansion was attained when alternated polarity is used (Figure 1b). Series and parallel electric connections were compared and the conversion of electric energy to mechanical energy was quantified. Also, a relationship between the mechanical force that is developed by the actuator and the combined number of trilayers was established and their performance was tested and evaluated.

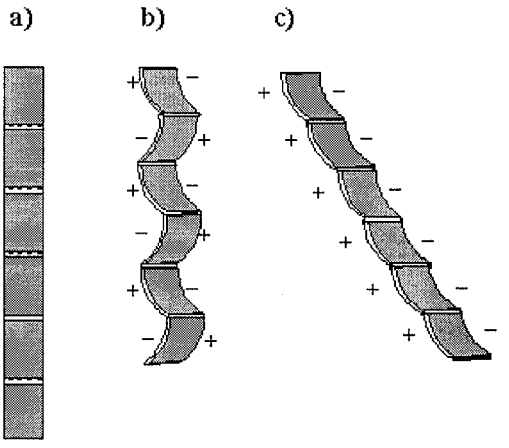

Fig.1: *Series configuration [PPy//SPE//PPy] trilayers:*

a) equilibrium position at open circuit
b) linear contraction/expansion movement using an alternated electric polarity
c) bending movement using same electric polarity