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Interpenetrating polymer network (IPN) as tool for tuning electromechanical properties of electrochemical actuator operating in open-air

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Highlights:

- Modulus of conducting polymer electrodes can be tuned via IPN architecture.
- Adjusting actuator's mechanical properties allows increasing its output force.
- The improved output forces are consistent with the predicted values from modelling.

Abstract

Electrochemical actuators operating in open-air are trilayer electrochemical devices based on an ionically conducting membrane sandwiched between two electrodes of electronic conducting polymers (ECP). Tuning functional properties of the actuator, i.e. the output force, is demonstrated via the modification of the ECP's surrounding macromolecular architecture. Theoretical models have suggested that the output force of trilayer actuators is related to the Young's modulus of the electrodes. As a consequence, we designed Interpenetrating Polymer Network (IPN) membranes combining three different polymer networks with a co-continuous morphology to act as a host matrix for ECP electrodes. Each of these polymer networks is chosen for a specific role: (i) poly(ethylene oxide) network providing ionic transport medium within the ECP electrodes, (ii) Nitrile Butadiene

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