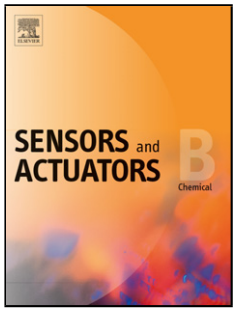

Title: Interpenetrating polymer network (IPN) as tool for tuning electromechanical properties of electrochemical actuator operating in open-air

Authors: Vincent Woehling, Giao T.M. Nguyen, Cedric Plesse, Sophie Cantin, John D.W. Madden, Frederic Vidal

PII: S0925-4005(17)31992-5
DOI: https://doi.org/10.1016/j.snb.2017.10.090
Reference: SNB 23394

To appear in: *Sensors and Actuators B*

Received date: 3-7-2017
Revised date: 9-10-2017
Accepted date: 16-10-2017

Please cite this article as: Vincent Woehling, Giao T.M.Nguyen, Cedric Plesse, Sophie Cantin, John D.W.Madden, Frederic Vidal, Interpenetrating polymer network (IPN) as tool for tuning electromechanical properties of electrochemical actuator operating in open-air, Sensors and Actuators B: Chemical https://doi.org/10.1016/j.snb.2017.10.090

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

Vincent Woehling [a], Giao T. M. Nguyen [*a], Cedric Plesse [a], Sophie Cantin [a], John D. W. Madden[b], Frederic Vidal [a]

[a.] Laboratoire de Physicochimie des Polymères et des Interfaces EA2528. Institut des Materiaux,Université de Cergy-Pontoise, 5 mail Gay Lussac, Neuville sur Oise, Cergy-Pontoise cedex 95031, France.
[b.] Electrical and Computer Engineering, The University of British Columbia, 3042 - 2332 Main Mall, Vancouver BC V6T 1Z4, Canada.
* corresponding author : tnguyen@u-cergy.fr

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