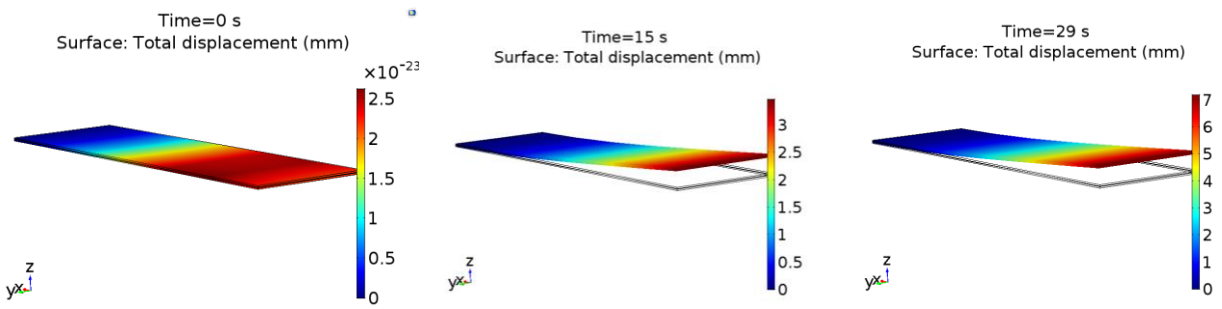
ELECTROMECHANICAL MODELLING OF IONIC ELECTROACTIVE POLYMER ACTUATORS

Sunjai Nakshatharan, Andres Punning and Alvo Aabloo

Institute of Technology, University of Tartu, Nooruse 1, 50411 Tartu, Estonia
E-mail of presenting author: sunjaina@ut.ee

Migration of ions under electric field is the phenomenon behind the mechanical deformation of ionic polymer actuators. This transport process is influenced by numerous factors depending on the physical, chemical and electrical properties of the material used [1]. Among them porosity and tortuosity are one of the main influencing factors that modifies ion channels and so the properties of the material [2]. In this work, microstructural mathematical analysis of ion transport and mechanical deformation of the ionic polymer actuator with porous electrode is examined. A three dimensional Multiphysics model of trilayer actuator with porous carbon electrodes and ion conductive separator membrane is presented. Porous electrode theory considering the effects porosity and tortuosity in each of the layer are incorporated in the model. The actuator samples are prepared and experiments are conducted in order to measure the key parameters and also to verify the accuracy of the developed model. Chemo electro and mechanical response models of the material are coupled together and solved numerically using finite element method. The result shows that the theoretical model developed was able to well predict the behaviour of the actuator. It is also shown that the conductivity, double layer capacitance and so the mechanical deformation is highly influenced by the porosity of the material. This study provides a comprehensive understanding of behaviour of ion transport in actuators made of porous carbon electrode.



References

1. J. Newman, 1991, Electrochemical *Systems*, 2nd ed., Prentice-Hall, Englewood Cliffs, NJ.
2. M. Ebner and V Wood, 2015, *Journal of the Electrochemical Society*, 162(2).

Euroopa Liit
Euroopa
Regionaalarengu Fond

Eesti
tuleviku heaks