Morphological and Electromechanical Characterization of Artificial Muscles Based on Ionomeric Polymer-Metal Composites (IPMC)

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The search for miniaturization and smooth movements in robotics has been leading to the development of new materials, which can move with the simple application of an electrical stimulus. The ionic transport properties of Nafion® make this material a strong candidate to replace rotational motors for small devices, when high level of force is not required. When an electric field is applied to a Nafion® membrane, a pressure gradient along the thickness, promoted by ions migration towards the anode, bends the membrane in a movement similar to those of biological muscles. However, despite the great potential of this type of actuator, there is no consensus on the mechanisms involved in the ion transportation as well as a reliable model to predict its behavior based on the electrical stimuli imposed. This fact has been limited its application. This presentation shows some advances made by our research group in the morphology characterization of IPMCs based on Nafion®, when stimulated by an electrical field. Experimental techniques such as Small Angle X-Ray Scattering (SAXS), Impedance Spectroscopy and Electromechanical Measurements are used to investigate the correlation between the electrical stimuli, environmental factors (such as relative humidity and temperature), morphology of the Nafion and the mechanical response of the IPMC. These results may be used in the future to define a more reliable model to explain how the ionic transportation is related to the bending movement of the material.