The Role of Microstructure on the Properties of Proton Exchange Membranes.

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Work will be described in which a variety of analytical techniques are employed to measure electrochemical and proton conduction properties of a wide range of different polyelectrolyte membranes possessing a wide range of equivalent weights and water contents. Proton conductivity is measured transverse and normal to the membrane surface under conditions of controlled humidity and temperature using a.c. impedance spectroscopy (up to 1 GHz).

Various proton conducting membranes possessing a series of equivalent weights have been investigated, including membranes based on polystyrene-*block*-hydrogenated butadiene, polystyrenesulfonic acid grafted onto ethylenetetrafluoroethylene, sulfonated trifluorostyrene- copolymers, and a novel series of membranes prepared in house and in which the internal biphasic morphology is controlled to yield materials with low water and high conductivity. The microstructure of selected membranes is analyzed by transmission electron microscopy. With the latter we will demonstrate that phase separation in proton exchange membranes is beneficial for membranes containing low water content (Figure 1). Important attributes of proton exchange membranes will be discussed in relation to fuel cell applications.

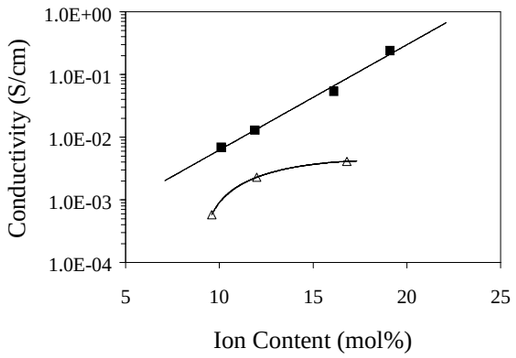

Figure 1. Proton conductivity of phase separated membrane (square) and homogeneous membrane (triangle) as a function of ion content.