

Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Decoupling Between Ionic Conductivity and Segmental Dynamics in Polymers ALEXANDER AGAPOV, Dept. of Polymer Science, Univ. of Akron and Dept. of Chemistry, Univ. of Tennessee, ALEXEI SOKOLOV, Dept. of Chemistry, Univ. of Tennessee and Chemical Sciences Division, ORNL — The idea of solid polymer-based electrolytes (SPE) with high ionic conductivity at room temperature is known in scientific community for more than three decades. The interest is caused by unique advantages these materials may offer: mechanical flexibility, high power density, enhanced environmental and operational safety, etc. However, even after several decades of studies, the main challenge remains – there is no “dry” SPE with conductivity of $\approx 10^{-2} - 10^{-3}$ S/cm at room temperature. Ionic conductivity is controlled by two parameters, number of ions and their diffusion. Traditional views relate the diffusion of ions in a polymer to the segmental relaxation. Thus, when segmental dynamics freeze the ion motion halts, leading to low conductivity in solid state. A very good example of a material with such behavior is poly(ethylene oxide). In this work we demonstrate that the temperature dependence of ionic conductivity and segmental relaxation can be decoupled in a material specific way. Degree of the observed decoupling exhibits strong correlation with the steepness of the temperature dependence of structural relaxation (fragility). We predict that more fragile materials can have higher ionic conductivity in the solid state than the strong polymers (e.g. PEO).

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Date submitted: 09 Nov 2010

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