

Lithium/polymer battery electrolytes: the poly(ethylene oxide)/lithium perchlorate system

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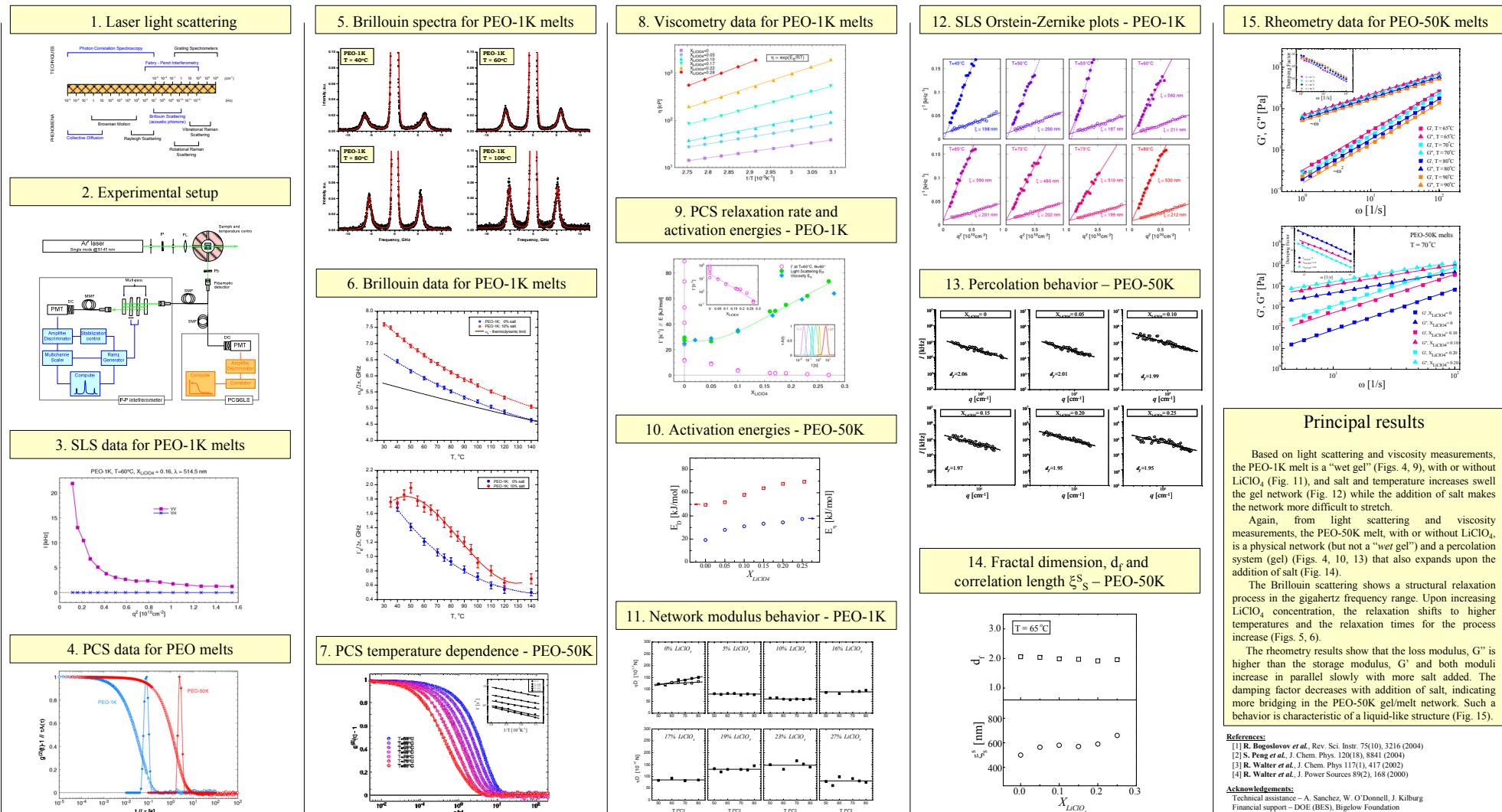
Carrier ion transport in state-of-the-art "solid" polymer electrolyte batteries is poorly understood. Already, shoe-box size SPE batteries using the "warm-dry" concept are used in telecommunications applications (www.avestor.com) with more applications – automotive applications perhaps foremost amongst them – coming soon. In this project, the "canonical" warm-dry system, molten PEO containing dissolved lithium salts, is being studied. In particular, to better understand lithium ion transport in molten PEO, an investigation of the structure and behavior of PEO melts with and without LiClO₄ is being carried out. Custom synthesized, narrow molar mass distribution, methyl-endcapped PEO samples employed in this study have molar masses distinctly below ("1K") and above ("50K") the critical value of 3,500 Da for entanglement.

Three light scattering techniques – static light scattering and the dynamic light scattering techniques of photon correlation spectroscopy and Fabry-Perot interferometry – along with viscometry and the dynamic mechanical technique of rheometry, are used in this study.

The poster presents a summary of the principal results of the work to date.

Introduction

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Principal results

Based on light scattering and viscosity measurements, the PEO-1K melt is a "wet gel" (Figs. 4, 9), with or without LiClO₄ (Fig. 11), and salt and temperature increases swell the gel network (Fig. 12) while the addition of salt makes the network more difficult to stretch.

Again, from light scattering and viscosity measurements, the PEO-50K melt, with or without LiClO₄, is a physical network (but not a "wet gel") and a percolation system (gel) (Figs. 4, 10, 13) that also expands upon the addition of salt (Fig. 14).

The Brillouin scattering shows a structural relaxation process in the gigahertz frequency range. Upon increasing LiClO₄ concentration, the relaxation shifts to higher temperatures and the relaxation times for the process increase (Figs. 5, 6).

The rheometry results show that the loss modulus, G'' is higher than the storage modulus, G' and both moduli increase in parallel slowly with more salt added. The damping factor decreases with addition of salt, indicating more bridging in the PEO-50K gel/melt network. Such a behavior is characteristic of a liquid-like structure (Fig. 15).

References:

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