

271e Peo Mobility in Nanoparticle-Filled Polymer Electrolytes as Measured by Neutron Scattering

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The mobility of poly(ethylene oxide) [PEO] is measured for solid polymer electrolyte systems of PEO/LiClO₄ and PEO/LiClO₄/Al₂O₃, where LiClO₄ is the lithium salt and Al₂O₃ is the nanoparticle filler (average diameter, 11nm). While the addition of nanoparticles has been shown to improve conductivity in solid polymer electrolytes, the molecular mechanism is not clear. Some authors suggest that the addition of nanoparticles increases PEO mobility and hence Li⁺ ion mobility. However, other authors suggest that nanoparticles act like crosslinkers, pinning PEO at the ether oxygen atoms, and creating a more direct route for Li⁺ ions. This mechanism suggests that PEO mobility is decreased. The glass transition temperatures [T_g] of polymer electrolytes filled and unfilled with nanoparticles differs by only a few degrees, making it difficult to interpret the influence of nanoparticle fillers on PEO mobility. However, PEO mobility can be measured directly by quasielastic neutron scattering [QENS], and has previously been used to measure a system of PEO/LiClO₄. We measure PEO mobility using the NG2 High-Flux Backscattering Spectrometer [HFBS] and the Disk Chopper Time-of-Flight Spectrometer [DCS] at the NIST Center for Neutron Research in Gaithersburg, Maryland. HFBS measures motion on a timescale between 240 ps and 2 ns, and DCS between 0.1 ps and 40 ps. PEO mobility is measured for filled and unfilled solid polymer electrolytes at 295K, 323K and 348K. Results indicate that the addition of nanoparticle filler decreases PEO mobility. Therefore, the influence of nanoparticle filler on conductivity supercedes that of increased segmental relaxations of PEO.