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Ion conduction in phosphonium-polysiloxane ionomers
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Penn State University — Low Tg ionomers with phosphonium cations covalently attached as side chains have potential application in energy conversion and storage devices. For example, alkaline fuel cells rely on membranes that transport hydroxide anions and some advanced batteries rely on membranes transporting fluoride anions. To better understand ion conduction in phosphonium-polysiloxane ionomers, allyl tributyl phosphonium bromide monomer was synthesized and, along with a vinyl ethylene oxide monomer, attached to polymethylhydrosiloxane by hydrosilylation. These ionomers maintain low Tg ≈ -74 °C with up to 10 mol% phosphonium and are fully water soluble, allowing easy anion exchange and purification. We report dielectric spectroscopy results for these ionomers with a variety of counter-anions. Electrode polarization at low frequencies is analyzed to determine the number density of simultaneously conducting counter ions and their mobility. This analysis reveals higher mobility and lower activation energy for conducting anions that are larger and more diffuse, such as bis(trifluoromethane sulfonyl)imide, contributing to better performance as anion-conducting membranes.

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