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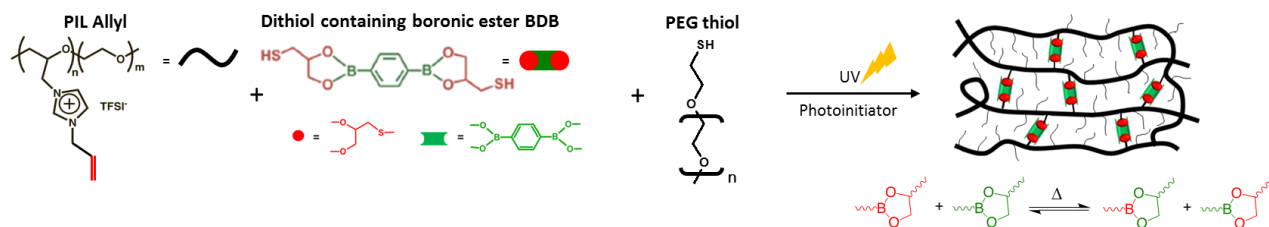
# Healable ionoelastomer based on poly(ionic liquid)

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**KEYWORDS:** poly(ionic liquid), ionoelastomer, vitrimer

**ABSTRACT:** Ionoelastomers are elastomer based on poly(ionic liquid) (PIL) and have been introduced recently as liquid-free and stretchable ionic conductors.<sup>1-3</sup> These ionically conducting materials find their applications in all-solid stretchable and wearable electrochemical devices. In this presentation, we report a novel PIL based on imidazolium and bis(trifluoromethanesulfonyl)imide synthesized from commercially available copolymer rubber of polyepichlorohydrin and poly(ethyleneoxide). The PIL bearing allyl functional groups was then crosslinked with dynamic boronic ester crosslinkers through thiol-ene photoaddition. The resulting ionoelastomers are healable via vitrimer chemistry of boronic ester transesterification. The effect of crosslinker and additional poly(ethylene glycol) based dangling chains acting as free volume enhancer has been studied on thermomechanical properties and ionic conductivities. At optimal conditions, the resulting ionoelastomer is soft with a Young modulus of 0.2MPa, stretchable up to 300% elongation, and exhibits an ionic conductivity of  $1.6 \times 10^{-5} \text{ S} \cdot \text{cm}^{-1}$  at 30 °C. In addition, the vitrimer properties of the material have been demonstrated with Arrhenius-type stress relaxation, healability, and recyclability. The recycled materials were able to retain their original mechanical and conductive properties. The reported material has allowed obtaining sustainable high-performance polymer materials with high ionic conductivity and by combing the facile processability of thermoplastics with the performance advantages of permanent crosslinked thermosets via vitrimer chemistry.



**Scheme 1: Scheme for the formation of ionoelastomer and the dynamic exchange of boronic ester function**

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