SELF-HEALING IONIC-LIQUID-BASED ELECTROLYTES

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Generating novel electrolyte-systems is of urgent need, for batteries as well as for supercapacitors acting as short-time power-storage devices. While solid electrolytes offer promising alternatives to conventional liquid electrolytes, they undergo irreversible failure during cycling. Intrinsic self-healing materials [1] based on dynamic bonds are suitable candidates as alternative electrolytes [2], since reversible bonding can compensate failure of the materials consequently extending the lifespan of a battery.

We here report on the use of supramolecular and dynamic covalent bonding systems to embed self-healing [3] and vitrimeric properties [4] into electrolyte-systems, requiring fundamental knowledge about bonding strength and dynamics in highly polar and even ionic-liquid environment. We have focused on two different bonding systems, one composed of hydrogen bonding-systems; the other of covalent dynamic bonds, enabling vitrimeric exchange during charge-transport through the electrolyte-medium. Additionally, mechanical properties of poly(ionic liquid)s were reinforced by covalent crosslinking and ionic conductivity was enhanced by incorporating ionic liquid/lithium salt mixture into polymer network (forming ion-gels). A critical factor is to maintain the dynamic feature in the temperature window of interest, still keeping the required ion-conductivities intact. The materials we are reporting herewith not only suffice these requirements, but also allow to embed self-healing properties into the final (solid) material. Furthermore, we demonstrate the 3D-printability of vitrimer-based electrolyte-composites [5].

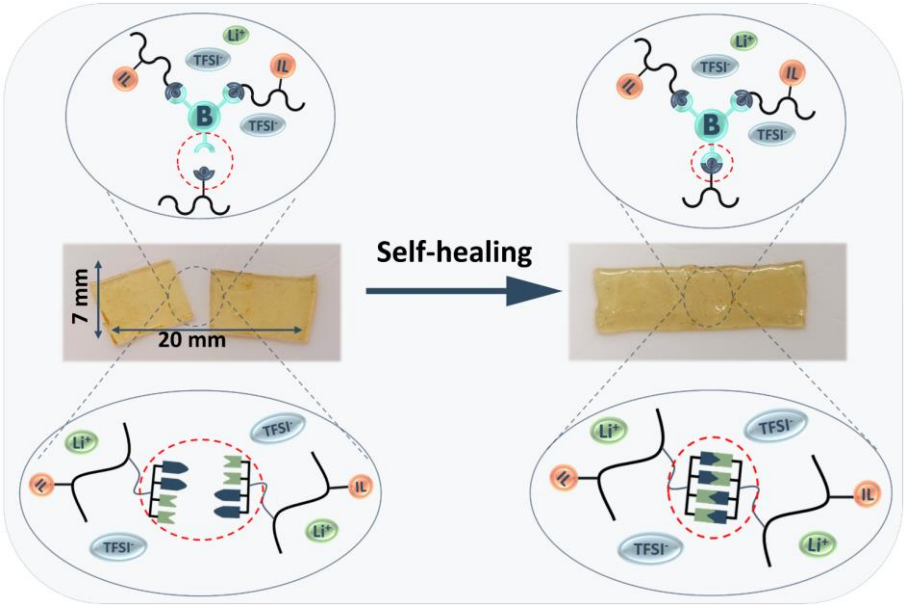

Figure 1. Schematic representation of self-healing mechanism.

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