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Deformation Relaxation Dynamics of Dioxaborolane Vitrimers

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Vitrimers are a variant of covalent adaptable networks (CANs), containing associative dynamic bonds. These materials have attracted widespread interest over the last decade due to their intriguing properties and promising role in facilitating a circular material economy [1]. However, the mechanisms by which vitrimers reorganise their macromolecular structure, such as how they relax after applied stresses, are often not fully understood.

Recent literature has reported vitrimers that show excellent material properties such as self-healing, energy dissipation and stretchability [2-3]. These qualities can sometimes be attributed to the dynamic exchange of crosslinks, though the detailed nature of how these properties arise is not well understood. Thus, a deeper understanding of how these materials adjust their structure to respond to external deformation would provide a more insight into how these materials perform over longer durations and their fracture behaviour. This would allow the tuning of materials to a range of applications [4].

Here, we present the synthesis and characterisation of a class of vitrimers which exploit dioxaborolane metathesis to achieve dynamic bond exchange. Tensile and rheological tests were performed to determine their linear response, as well as their behaviour under deformation. We also explore whether the application of both small and wide-angle X-ray scattering alongside birefringence studies can give insights into how the material structure varies with deformation under different degrees of deformation.

References:
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