Investigation of the structure of sodium borates and silicoborates at high temperature in both solid and molten states using high-temperature NMR

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Abstract

Boron-containing glasses exhibit extensive applications in various fields, such as temperature- and chemical-resistant containers, fiber composites, optical components, display screens, and bioactive materials. The properties of these glasses are predominantly governed by the structures of their liquid precursors, which undergo increasing order during cooling and solidify during the transition to glass. The dynamics of this structural evolution are particularly intriguing as they influence the location of the transition and are intricately linked to viscosity and diffusivity. Given that microscopic processes dictate the macroscopic properties of these materials, obtaining atomic-scale information on both structure and dynamics with changing temperature is imperative. This study focuses on investigating the structural properties of various boron glasses at elevated temperatures. High-temperature nuclear magnetic resonance (HT NMR) (see Fig.1) and magic angle spinning (MAS) NMR techniques were employed to analyze different compositions of sodium borates and silicoborates glasses. The high-temperature experiments were carried out under a nitrogen (N2) atmosphere, reaching temperatures up to 1100○C. Utilizing the information from high-temperature NMR 11B spectra obtained at high magnetic field (17.6 T), we proposed structural models to establish a comprehensive framework describing the physical characteristics of these glasses. Fig. 1. High temperature NMR experimental setup

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