Session	Materials Science in Glass (I)
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Chair	Dr. İlkay Sökmen

Ultrafast and Energy-Efficient Crystallization of Glasses for All-Solid-State Battery Applications: A Case Study of $Li_{1.5}Al_{0.5}Ge_{1.5}(PO_4)_3$

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Biography

I'm passionate about glass science and technology, and right now, I'm working on developing new ways to crystallize glasses. My research focuses on applications like solid electrolytes for batteries and glass-ceramics for dental materials. I love exploring creative approaches to improve how these materials work in real-world uses.

Abstract

Ceramic materials typically exhibit higher ionic conductivity in their amorphous states compared to crystalline counterparts. NaSICON phases stand out as an exception, offering ionic conductivities several orders of magnitude higher than their glass equivalents. This makes them particularly attractive for solid-state electrolytes in battery applications. NaSICON-based materials are commonly synthesized via the glass-ceramic route, which involves glass melt-quenching followed by controlled crystallization. This method provides excellent microstructural control and enables the production of high-density glass-ceramics. However, conventional crystallization processes often require prolonged high-temperature treatments, leading to volatilization of light elements such as Li and Na, which negatively impact material performance. In this study, we utilized an ultrafast technique, which employs Joule heating through carbon felt layers to achieve rapid and energy-efficient heating. This approach was applied to bulk pieces of $Li_2O–Al_2O_3–GeO_2–P_2O_5$ glass system, enabling crystallization within seconds while minimizing Li volatilization. The resulting glass-ceramics exhibit a high crystalline volume fraction and a pure NaSICON phase structure with excellent ionic conductivity at room temperature. These findings suggest that said technique offers a rapid and energy-efficient approach to glass crystallization, making it particularly suitable for glasses containing highly volatile elements.

Notes

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