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Beginning temperature of the silica-glass transition

Shangcong Cheng
Molecular Foundry, Lawrence Berkeley National Laboratory, Berkeley, CA, USA.

INTRODUCTION & AIM

Understanding the complexity of glass formation remains a significant challenge in materials science. Solving the mystery of dynamic processes during the glass transition involves answering key questions about where and why the transition begins and ends during the cooling process.

METHOD

This study focuses on silica glass, considered to be the most fundamental glass-forming material. The research community has gathered extensive experimental data on both the physical properties and analytical techniques related to silica crystals and silica glass. These data can be used to assess new theories. This study recognizes that both the crystal and glass forms of silica are made up of SiO_4 tetrahedra. A thorough understanding of the crystallization process requires knowledge of how SiO_4 tetrahedra behave under different temperatures during slow-cooling. Based on this understanding and fundamental physical laws, it becomes possible to predict how SiO_4 tetrahedra react during rapid cooling. The available experimental data can help to verify the accuracy of these predictions. Once the silica glass transition process is understood, the insights gained can also be applied to the transitions of more complex glasses.

RESULTS & DISCUSSION

This analysis indicates that, during rapid cooling, silica structures within the temperature range from the melting point to the polymorphic inversion temperature, 1470°C, are heterogeneous, featuring embryonic clusters, and at 1470°C begin to shift toward more stable structures. Experimental data confirm that this is a continuous structural transition occurring over several hundred degrees.

CONCLUSION

It is concluded that the silica glass transition can be identified as a second-order phase transition, resulting in a glass state with a unique structure and properties that differ from those of liquid and crystalline silica. The method for determining the glass transition temperature at which the transition begins is straightforward and can also be applied to complex silicate glasses.

FUTURE WORK / REFERENCES