Impact of structural ordering in supercooled liquids on glassy slow dynamics and glass-forming ability

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Abstract

Dynamics of a liquid drastically slows down when approaching the glass transition. Despite a long history of research, its physical origin has remained elusive. We show evidence of intrinsic structure-dynamics correlation in glass-forming liquids [1-3]. We find that there exist two intrinsic characteristic lengths, the particle size and structural correlation length, which control dynamics in local and nonlocal manners, respectively, resulting in the emergence of the two key relaxation modes, fast beta and slow alpha processes [3]. The presence of such intrinsic structure-dynamics correlation strongly indicates a thermodynamic nature of glass transition. We also discuss the impact of structural ordering on crystal nucleation, or glass-forming ability [1,4-7]. The similarity between structural order formed in a supercooled liquid and the crystal structure is the key control factor of the ease of crystal nucleation: A liquid having stronger frustration against crystallization is more difficult to crystallize, or the better glass-former.

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