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Microscopic origin of the fragile-to-strong transition in glass-forming liquids

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The fragile-to-strong transition (FST) occurs in many glass-forming liquids during cooling from above liquidus (T_{liq}) towards glass transition temperature (T_g). Some liquids exhibit FST above T_{liq} (e.g. silica), while other show FST in the supercooled regime (e.g., water, metals). FST is a fascinating dynamic phenomenon accompanied with a thermodynamic transition. FST must be associated with a structural transition within medium range. However, this structural transition is extremely difficult to be probed due to severe crystallization during FST. Recently we have obtained some implications on the structural transition by sub-T_g relaxation and diffraction studies. Here we describe our understanding about the microscopic origin of FST based on our recent findings. We propose a structural model to explain why FST can occur. We also point out major challenges and perspectives in attaining an overall picture of FST. This picture will be crucial for understanding general glass dynamics and glass transition, and also helpful for studying physical properties of the glasses derived from FST liquids, and hence for designing new glassy materials.

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