Fragile-to-strong transition: a possibly universal feature of metallic glass-forming liquids

A keynote talk

Yue, Yuanzheng; Zhang, C. Z.; Hu, L. N.; Mauro, John C.

Publication date:
2010

Document Version
Publisher's PDF, also known as Version of record

Link to publication from Aalborg University

Citation for published version (APA):
Fragile-to-strong transition: a possibly universal feature of metallic glass-forming liquids

Yuanzheng Yue\textsuperscript{1,2,3}, Chunzhi Zhang\textsuperscript{2}, Lina Hu\textsuperscript{2}, John C. Mauro\textsuperscript{4}

\textsuperscript{1}Section of Chemistry, Aalborg University, DK-9000 Aalborg, Denmark
\textsuperscript{2}Laboratory of Liquid Structure and Heredity of Materials, Shandong University, Jinan 250061, China
\textsuperscript{3}Key Laboratory of Glass and Ceramics, Shandong Institute of Light Industry, Jinan 250353, China
\textsuperscript{4}Science and Technology Division, Corning Incorporated, Corning, New York 14831, USA

Liquid fragility, which describes the degree of the non-Arrhenian viscous flow of glass-forming liquids at the glass transition temperature ($T_g$), is one of the most intriguing topics in modern glass physics. In particular, the fragility of metallic glass-forming liquids (MGFLs) remains a fascinating puzzle, as no existing viscosity model is capable of describing the dynamics over the full range of temperatures. In this presentation, we attempt to clarify this puzzle by separately examining the dynamic behaviour of both the equilibrium liquid at high temperature and the metastable supercooled liquid near $T_g$. Remarkably, we find that a fragile-to-strong (F-S) transition occurs in all of the MGFLs under study. This suggests that the F-S transition is not limited to a few liquids like water and silica, but is apparently a universal behaviour of MGFLs. The degree of the F-S transition is determined for each of the studied MGFLs. In addition, we propose a model for the F-S transition that accurately captures the scaling of dynamics across both the fragile and strong regimes and provides physical insights into the origin of the fragile-to-strong transition.