Wide Temperature Range Measurements of Molten Oxide Viscosity Using a Levitation Technique and Rotating Bob Method for Understanding the Glass Transition from the Viewpoint of Fragility

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Viscosity is the important thermophysical properties for understanding glass transition mechanisms. However, the viscosity of molten oxides, which are the most popular materials showing glass transitions in under cooling regions, have not been obtained in a wide high temperature range over its melting temperatures because it is difficult to measure them in high temperature. Recently, using an aerodynamic levitation (ADL) methohd with the oscillating drop technique [1], we succeeded in obtaining viscosity of molten oxides, such pure Al_2O_3, SiO_2-CaO-Al_2O_3 system and welding-flux, in the high-temperature range over 2200 K [2]. In our viscosity measurements using ADL, we used two sound speakers with phase matching that were set in the small chamber inserted into a gas flow path between a mass-flow controller and the conical nozzle for ADL. Using the system, we can only generate the surface oscillation of ADL droplet of molten oxides with low viscosity in high-temperature regions. Therefore, in low-temperature regions below 1800 K viscosity of molten oxides increase rapidly over 100 mP・s, so we could not apply the oscillating drop technique. In the low-temperature range, we measured viscosity by the rotating bob method. From these measurements, we obtained the temperature dependence of viscosity of molten oxides. These wide temperature dependences of viscosity of molten oxide were applied to an Angel plot [3], which shows the legalism viscosity with Tg/T (Tg, assumed glass transition temperature). Using the temperature dependence of viscosity of molten oxides, we would like to discuss the glass transition mechanism from the viewpoint of fragility.

References:

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