

Is water an ultraviscous liquid above 125 K? Experiments on Droplet Coalescence

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Glassy water has been made for the first time in the laboratory in 1935. Its glass transition temperature was reported for the first time in the early 1980s. Right after the first report of the increase in heat capacity near 136 K in calorimetry experiments at standard heating rates (20 K min⁻¹) the discussion about the nature of the glass transition has started, and this discussion is still going on. The major question is whether or not the glass transition thermodynamically connects the glass to the liquid. Arguments can be found in literature both in favor of only orientational motions being unlocked at the glass transition temperature and in favor of translational motions being unlocked at the glass transition. The latter means that the glass transition is coupled to an alpha-relaxation and viscosity. Yet, direct measurement of viscosity are missing up to the current day. Here I present our recent work on hyperquenched glassy water, which is composed of thousands of micron-sized droplets. Based on SAXS/WAXS measurements at PETRAIII and the EuXFEL and based on direct observation by cryo-microscopy we show that water droplets actually start to coalesce near the glass transition temperature, i.e., capillary forces typical of viscous liquid awaken near the glass transition temperature and cause the droplet interfaces to disappear. This represent the first demonstration of true viscous nature of glassy water in the glass transition temperature range

Keywords

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