Nucleated bubbles in glass former liquids undergoing coalescence and growth

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Abstract

2D spatial distributions and growths of nucleated bubbles during the remelting of glass samples forming by float process are experimentally investigated. To follow the bubble population undergoing coalescence, the temporal behavior of the Voronoi tessellation built by the bubble positions are monitored. During coalescence, the Voronoi cell areas are fitted by a single parameter Gamma distribution.
Numerical time simulation of population of bubbles undergoing coalescence shows an exponential increase of the parameter associated to the Gamma distribution with the fraction of coalesced bubbles in agreement with experimental observation. An initial density of nuclei is then estimated; direct observation would require an extremely high space resolution.
The bubble number density is two orders of magnitude larger on the side which was in contact with tin bath than on the other side in contact with atmosphere. Moreover, bubbles grow faster on tin side. From a thermodynamic and mass transfer models, we prove that tin reduces the glass former liquid which leads to an increase of dissolved sulfur explaining the more abundant
bubble population and the enhanced growth rate on tin side.

Keywords: remelting, cullet, bubble nucleation, growth, redox reactions

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