Can homogenous nucleation be controlled in a metallic glass?

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Fast scanning chip calorimetry was successfully employed to not only suppress crystallization but also bypass homogeneous nucleation of an Au-based bulk metallic glass on controlled fast quenching. A truly amorphous metallic glass without homogeneous nucleation was acquired. Following the rapid quenching, annealing at different temperatures from 0.001 s to 10000 s was realized, in which homogeneous nucleation was allowed and various local-configurations were obtained consequently. Its effect on crystallization was quantified based on the evolution of enthalpy employing nuclei development approach. Finally, a C-curve illustrating the homogeneous nucleation kinetics was obtained and added to the conventional TTT diagram, by which a truly amorphous state and the kinetics of homogeneous nucleation can be estimated. The art to control homogeneous nucleation and the science to uncover the corresponding mechanism provide new insights how to tune the micro- to nano-structure of metallic glasses, and facilitates the understanding of solidification and glass forming ability both in engineering and scientific fields.