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Continuous chemical redistribution following amorphous-to-crystalline structural ordering in a Zr-Cu-Al bulk metallic glass

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Bulk metallic glasses (BMGs) are thermodynamically metastable. As such, crystallization occurs when a BMG is thermally annealed at a temperature above the glass transition temperature. While extensive studies have been performed on the crystallization kinetics of BMGs, most of them have focused on the amorphous-to-crystalline structural ordering, and little attention has been paid to chemical distribution and its relationship with the structural ordering during the crystallization process. In this paper, a new approach, with simultaneous differential scanning calorimetry (DSC) and small angle neutron scattering (SANS) measurements, was applied to study in situ the crystallization of a Zr45.5Cu45.5Al9 BMG upon isothermal annealing at a temperature in the supercooled liquid region. Quantitative analysis of the DSC and SANS data showed that the structural evolution during isothermal annealing could be classified into three stages: (I) incubation; (II) amorphous-to-crystalline structural ordering; (III) continuous chemical redistribution. This finding was validated by composition analysis with atom probe tomography (APT), which further identified a transition region formed by expelling Al into the matrix. The transition region, with a composition of (Cu,Al)50Zr50, served as an intermediate step facilitating the formation of a thermodynamically stable crystalline phase with a composition of (Cu,Al)10Zr7.

Level of Expertise

Early Career <5 Years

Presenter Gender

Woman

Pronouns

She/Her

Which facility did you use for your research

Australian Centre for Neutron Scattering

Students Only - Are you interested in AINSE student funding

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Condition of submission

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