Low-density to high-density transition in Ce\textsubscript{75}Al\textsubscript{23}Si\textsubscript{2} metallic glass

Q.S. Zeng\textsuperscript{1,2}, Y.Z. Fang\textsuperscript{3,4}, H.B. Lou\textsuperscript{1,2}, Y. Gong\textsuperscript{1,2}, X.D. Wang\textsuperscript{1,2}, K. Yang\textsuperscript{5}, A.G. Li\textsuperscript{6}, S. Yan\textsuperscript{5}, C. Lathe\textsuperscript{6}, F.M. Wu\textsuperscript{3}, X.H. Yu\textsuperscript{5}, and J.Z. Jiang\textsuperscript{1,2}

1 International Center for New-Structured Materials, Zhejiang University, Hangzhou 310027, People’s Republic of China
2 Laboratory of New-Structured Materials, Department of Materials Science and Engineering, Zhejiang University, Hangzhou 310027, People’s Republic of China
3 College of Mathematics, Physics and Information Engineering, Zhejiang Normal University, Jinhua 321004, Zhejiang, People’s Republic of China
4 School of Material Science and Engineering, Xi’an University of Architecture and Technology, Xi’an 710055, People’s Republic of China
5 Shanghai Institute of Applied Physics, Chinese Academy of Sciences, Shanghai 201203, People’s Republic of China
6 HASYLAB am DESY, Notkestrasse 85, Hamburg D-22603, Germany

Using in situ high-pressure x-ray diffraction (XRD), we observed a pressure-induced polyamorphic transition from the low-density amorphous (LDA) state to the high-density amorphous (HDA) state in Ce\textsubscript{75}Al\textsubscript{23}Si\textsubscript{2} metallic glass at about 2 GPa and 300 K. The thermal stabilities of both LDA and HDA metallic glasses were further investigated using in situ high-temperature and high-pressure XRD, which revealed different pressure dependences of the onset crystallization temperature (Tx) between them with a turning point at about 2 GPa. Compared with Ce\textsubscript{75}Al\textsubscript{25} metallic glass, minor Si doping shifts the onset polyamorphic transition pressure from 1.5 to 2 GPa and obviously stabilizes both LDA and HDA metallic glasses with higher Tx and changes their slopes dTx /dP. The results obtained in this work reveal another polyamorphous metallic glass system by minor alloying (e.g. Si), which could modify the transition pressure and also properties of LDA and HDA metallic glasses. The minor alloying effect reported here is valuable for the development of more polyamorphous metallic glasses, even multicomponent bulk metallic glasses with modified properties, which will trigger more investigations in this field and improve our understanding of polyamorphism and metallic glasses.

References