Anomalous compression behavior in LaCe-based metallic glass under high pressure


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In situ high pressure x-ray diffraction, low-temperature resistivity and magnetization experiments were performed on a La$_{32}$Ce$_{32}$Al$_{16}$Ni$_5$Cu$_{15}$ bulk metallic glass (BMG). A sudden change in compressibility at about 14 GPa and a rapid increase of resistivity at around 12 K were detected while magnetic phase transformation and magnetic field dependence of the low-temperature resistivity do not occur at temperatures down to 4.2 K. An interaction between conduction electrons and the two-level-systems was suggested to explain the temperature and field dependences of resistivity of the BMG alloy. Although the cause of the unusual change in compressibility at about 14 GPa is not clear, we believe that it could be linked with the unique electron structure of Cerium in the amorphous matrix. An electronic phase transition, most likely a second-order amorphous-to-amorphous phase transition, was suggested in BMG alloys for the first time. The work has been carried out at BW5 for XRD and A1,E4, and X1 for XAFS measurements.

References