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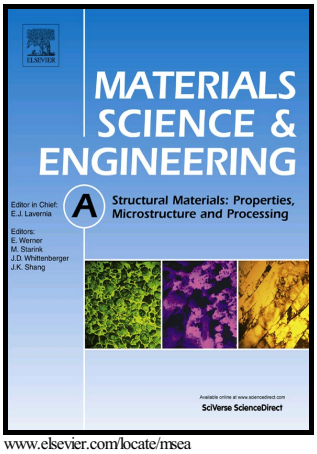

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Fatigue damage and fracture behavior of metallic glass under cyclic compression

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Abstract

A comprehensive understanding on the fatigue behavior of metallic glasses (MGs) is of vital importance for their structural applications. Here we present a systematic study on the fatigue damage and fracture behavior of a $Zr_{52.5}Cu_{17.9}Ni_{14.6}Al_{10}Ti_5$ MG under cyclic compression of different stress levels, with the assistance of 3D X-ray tomography (XRT) and 2D scanning electron microscope to examine the origins of fatigue cracks. The results indicate that the fatigue fracture mode of the MG depends strongly on the stress level in such a manner similar to that of high-strength steels. The MG exhibits shear fracture along shear band under high cyclic stress level, just like the case for monotonic compression; under low cyclic stress level, in contrast, the fracture is dominated by splitting where the fatigue cracks originate from extrinsic defects. The increased propensity for cavitation and cracking under low stress level, as revealed by XRT, suggests a reduced resistance of the MG to cleavage failure which eventually leads to the transition of the fatigue fracture mode. The results support the idea that the fatigue performance of MGs can be improved by reducing the extrinsic defects and properly controlling the shear banding behavior.

Keywords: Metallic glass; Fatigue crack; Shear band; Defect; Fatigue fracture mode.

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