4th Seminar on Mechanical Science and Bioengineering
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Deformation and Fracture Behavior of Bulk Metallic Glasses under Impact Loading

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Abstract: Several topics related to impact engineering performed at ANU are reported. Metallic glasses are amorphous meta-stable solids and are now being processed in bulk form suitable for structural applications including impact. Bulk metallic glasses have many unique mechanical properties, however, only a few studies could be found mentioning the dynamic response and damage of these metallic glasses under impact or shock loading. Firstly, the deformation behavior of bulk metallic glass under different loading rates was discussed. Indentation tests using a WC ball of 3 mm in diameter were carried out under quasi-static and impact condition. In addition, a small explosive detonator for the dynamic indentation on a Zr-based bulk amorphous metal was employed to evaluate the damage behavior of bulk amorphous metal under impact or shock loading. These results were compared with those of spherical indentation under quasi-static and impact loading. The interface bonded specimen method was also adopted to observe the appearances of subsurface damage induced during indentation under different loading conditions. Secondly, the impact fracture behaviors of BMGs using the fatigue precracked subsize Charpy specimen was investigated. It was found that most of fracture energy absorbed was used in the process of crack initiation from a notch tip. For impact fracture experiments, a newly devised instrumented impact testing apparatus was devised, where the impact load applied was measured by semi-conductor gages attached on an impact bar of 20 mm in diameter. A fatigue precrack was introduced to $a/W \approx 0.4$. The impact absorbed energy in the Zr-BMGs specimen with precrack was significantly low as compared with the notched Zr-BMGs specimens. Less shear bands were developed near the precrack tip and during crack propagation. The development of shear bands during crack propagation was also less as compared with the case of notched Zr-BMGs specimen. Finally, the fracture behaviors of laminated BMG based composites comprising Zr metal layers were investigated under impact loading and examined the morphologies of shear bands developed in each BMG layer with propagation of cracks. Generally, the energy absorbed until failure increased, as the number of metal layers in the composites increases.