Deformation dynamics in Mg based metallic glass described by Poisson statistics

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Deformation in metallic glasses occurs by formation and propagation of multiple thin shear bands. This mode is rather difficult to analyse since generally, a single band soon propagates to a large extent in the specimen leading to a catastrophic failure. Exceptions are for example in creep tests under low stress and moderate temperature [1] or in confined deformation tests. We used instrumented nano-indentations to perform series of independent experiments at room temperature on a Mg65Cu12.5Ni12.5(Ce75La25)10 metallic glass. Loading part of the curves shows serrations which size and time between two successive events were measured using an automatic procedure. To make analyses consistent, data were considered only in the domain of the curves with similar strain rates, in the range of 1 to 0.3 s^{-1}. Times between successive serrations follow a normal distribution characterizing a random occurrence of deformation burst in the glass. It was then conjectured first that serration occurs through activation of appropriate zone in the glass that should naturally scale with a multiple of an elementary size characterizing the deformation mechanism. Second, as activated zones leading to serration are very few in the glass, the model should be described by the Poisson statistics. Data analyses reveals that serration size are well fitted by a Poisson distribution. The model predict an elementary size which scale with the size of the activation volume of 3 atoms, measured from creep test at constant load in the same series of experiments [2].

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