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Using severe plastic deformation to fabricate strong metal matrix composites

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Abstract

It is now well established that processing a bulk metal through the application of severe plastic deformation leads to significant grain refinement and a consequent strengthening of the material. High-pressure torsion (HPT) generally refers to the processing of disk samples and this technique is especially effective in producing extremely small grains. Recently, new experiments were conducted in which disks of two different alloys, based on aluminum and magnesium, were stacked together and then processed by HPT for up to 10 turns at room temperature. Analysis after processing revealed the formation of a multi-layered structure in the central region of the disks but with nano-layers of Al_3Mg_2 within an Al matrix at the edges of the disk and with evidence for the presence of $\text{Al}_{12}\text{Mg}_{17}$. The results demonstrate the production of a metal matrix composite having a very high strength-to-weight ratio. Therefore, these results confirm the potential for using HPT processing in order to fabricate materials with exceptionally high strength.