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Metallic glass matrix composites

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ABSTRACT

The mechanical properties of *ex-situ* and *in-situ* metallic glass matrix composites (MGMCs) have proven to be both scientifically unique and of potentially important for practical applications. However, the underlying deformation mechanisms remain to be studied. In this article, we review the development, fabrication, microstructures, and properties of MGMCs, including the room-temperature, cryogenic-temperature, and high-temperature mechanical properties upon quasi-static and dynamic loadings. In parallel, the deformation mechanisms are experimentally and theoretically explored. Moreover, the fatigue, corrosion, and wear behaviors of MGMCs are discussed. Finally, the potential applications and important unresolved issues are identified and discussed.

Contents

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1. Introduction

1.1. Development of bulk metallic glasses

Before 1960, highly-disordered arrangements of atoms, similar to that of a liquid state, have never been found in solid metals and alloys. In 1960, the first reported metallic glass, scientifically obtained, was the alloy, $Au_{75}Si_{25}$ (It is noted that all of the compositions in the text are in atomic percent, at.%) produced at the California Institute of Technology (Caltech) of USA by Klement et al. [1]. The so-called metallic glass is the one that retains the disordered atomic structure of high-temperature melts. Fig. 1(a) shows the amorphous structure of the equimolar CuZr alloys with 200 atoms by computer simulations. It is impossible to locate the atoms by translation and rotation operations in the disordered structure. In contrast, atoms in the equimolar cubic crystalline