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Amorphous Zr-Cu metallic alloys prepared by magnetron co-sputtering

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A combination of appropriate metallic elements results in a formation of amorphous metallic alloys with properties superior to their polycrystalline counterparts. If these alloys exhibit the glass transition before crystallizing, they are called metallic glasses. Magnetron sputtering, as a non-equilibrium process with high cooling rates, is a proper technique for the preparation of such metastable materials as thin films.
In the present study, we focus on the preparation of amorphous metallic alloys from the Zr-Cu system by magnetron co-sputtering and on detailed investigation of the effect of the elemental composition and process parameters on film properties. The Zr-Cu films were deposited using two magnetrons with Zr and Cu targets in pure argon. The magnetron with the Zr target was operated in a dc regime while the magnetron with the Cu target in a pulse regime either at low or high density discharge conditions. The Zr and Cu contents in the films were controlled in a wide range (from 10 to 90 at.% Cu) by adjusting the dc power and/or the pulse repetition frequency. The films were deposited onto substrates held at a floating potential and mounted on a rotating substrate holder. Particular attention is paid to characterization of the structure, microstructure, surface and mechanical, electrical and thermal properties. Preliminary results show that Zr-Cu films are amorphous in a very wide composition range (from 18 to 90 at.% Cu). The glass transition is, however, observed only in a limited composition interval. An increasing Cu content in the films results in (a) a shift of a very broad diffraction peak to higher 2θ values, (b) an increase of the hardness reaching a maximum (~7GPa) between 70 to 80 at.% Cu, and (c) an increase of the crystallization temperature. In addition, the films exhibit very smooth surface and high water contact angle (> 100°). Further experiments, including an addition of other elements, will be presented as well.

Keywords
Zr-Cu
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