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Innovative Zr-Cu-(Ag) thin film metallic glasses deposed by magnetron PVD sputtering for biomaterials applications

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Due to the lack of dislocation-like crystalline defects and no long-range structural periodicity, bulk metallic glasses (BMG) display attractive physical and chemical properties. They have been intensively studied but metallic glasses are however generally limited to relatively small sizes in order to achieve fast quench rates. Also, thin film metallic glasses (TFMG) has recently emerged as alternative film materials for many applications, such as biomedical use [1]. On the other hand, physical vapor deposition (PVD) techniques like sputtering make possible synthesis of TFMG in an extended range of compositions. It has been especially demonstrated that binary Zr-Cu films [13-85 at.%Cu], presenting a glassy-like microstructure, can be obtained using pure Cu and Zr targets [2, 3]. Nosocomial infections are commonly associated with the transmission of pathogens from medical instruments or devices. Conventional biomaterials generally do not exhibit intrinsic antibacterial properties. Moreover, it is well establish that metallic ions, such as Ag and Cu, added in adequate amount can be an effective antimicrobial agent [4]. As an example, Zr-Cu-Ag-Al TFMGs investigations have recently shown promising antibacterial properties, due to the low roughness of surfaces and ions release [5-6]. In the present work, binary Zr-Cu and ternary Zr-Cu-Ag TFMGs were elaborated by PVD magnetron sputtering using multi-targets reactors. Structural, microstructural, mechanical, and electrochemical properties and thermal stability were characterized. These films are amorphous, smooth and display high hardness and an interesting passive behavior. Finally, the antibacterial activity of these TFMGs against E. Coli and S. Aureus were evaluated.

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