HRTEM Unveiling In-situ Crystallization of Cu-Zr Glassy Thin Film obtained by Magnetron Sputtering

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Amorphous and nanocrystalline thin films can improve surface properties of materials and corrosion resistance through significant improvements in its properties. Metallic thin films can be obtained through techniques such as co-condensation by means of thermal evaporation in high vacuum atmosphere or ion-magnetron sputtering, which is widely used for synthesis of amorphous metallic thin films. The amorphous alloys thin film are generally called as thin film metallic glasses (TFMG), Because of excellent three-dimension forming ability, good corrosion resistance, and mechanical properties, compared to conventional crystalline film counterparts, TFMGs are suitable for MEMS applications, such as conical spring linear micro-actuators and nano-device applications. Amorphous (ATF) and glassy thin films (GTF) Cu-Zr binary systems were deposited (30 nm and 1 micron thickness films) by RF and DC Magnetron Sputtering onto Si substrates (10x10x1mm^3) and were characterized by X-ray diffraction (XRD), differential scanning calorimetry (DSC), atomic force microscopy (AFM), scanning (SEM) and transmission electron microscopy (TEM) and subjected to nanohardness measurements. Glassy thin films (GTF) were obtained for $Cu_{50}Zr_{50}$, $Cu_{64}Zr_{36}$ and $Zr_{64}Cu_{36}$ (at%) alloys, showing only broad amorphous halo in the XRD patterns, granular growth morphology analyzed by SEM and AFM. Depending on dose and energy of the electrons in the incident beam, the crystallization can occur by atomic displacement events [2]. Usually crystallization of amorphous and bulk metallic glasses takes place upon heating by thermal annealing at crystallization temperature (T_x) of the alloy. In the present study, T_x is around 450^{o}C for $Cu_{50}Zr_{50}$ (at%) alloy, which is much higher than the expected from the electron beam heating of the samples inside TEM [Ref?!?].

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