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Zr and Mo thin films with reduced residual impurities' uptake under high vacuum conditions at room temperature

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In recent years, refractory metals, such as molybdenum (Mo) and zirconium (Zr), have been studied as infrared (IR) reflectors in solar absorber applications [1, 2]. The sputter process parameters are very important for depositing a high-quality thin film achieving the necessary low emittance. IR reflectance of the metal film is influenced by the film microstructure, presence of residual impurities and surface roughness. The main objective of the present study is to prepare Mo and Zr metallic thin films with improved optical properties by high-power impulse magnetron sputtering (HiPIMS) at room temperature under high-vacuum conditions. In comparison to the Mo and Zr thin films deposited by direct current magnetron sputtering (dcMS) at the same average power, thin films deposited by HiPIMS exhibit a dense microstructure without voids, grow preferentially in out-off-plane direction, have smooth surface and are free of residual contaminants. Compared to the dcMS films, we observed an element-specific reduction of impurities measured by elastic recoil detection analysis (ERDA) by a factor of 4 or 8 for N, 3 or 4 for H and 9 or 14 for O for Mo and Zr thin films, respectively. The compositional effects are correlated with differences in the film morphology and microstructure revealed by scanning electron microscopy (SEM), X-ray diffraction (XRD) and transmission electron microscopy (TEM) analysis.
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