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Synthesis and Characterization of CrZr–O–N Films Using Cr–Zr Segment Targets by Unbalanced Magnetron Sputtering

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The Cr-Zr-N films have much improved mechanical properties and very smooth surface roughness. However, in spite of their outstanding properties, the Cr-Zr-N coatings revealed their mechanical properties deteriorated severely with increasing Zr content at 500°C because of very rapid oxidation. Recently oxynitride films have been widely studied due to their excellent unique mechanical properties and oxidation resistance. In this work, CrZr-O-N films with various O contents were synthesized by unbalanced magnetron sputtering with Cr-Zr segment targets (Cr:Zr volume ratios is 1 : 1) and all films were prepared in a nitrogen rich mixture of N₂ and O₂. Characteristics such as crystalline structure, hardness and chemical composition as a function of the O content were investigated by X-ray diffraction (XRD), field emission scanning electron microscope (FE-SEM), microhardness testing system and energy dispersive spectroscopy (EDS). Results showed that the thin films had dense and compact microstructure as O content in the films increases. The microstructure of the thin films consisted of mainly crystalline Cr (Zr)N phase and Cr₂O₃ phase. The maximum hardness and elastic modulus of the films was measured to be approximately 33.2 GPa and 280.6 GPa from the films with low content of O elements. Detailed experimental results will be presented.

Keywords: CrZr-O-N films, Oxynitride, Crystalline structure, Hardness