INFLUENCE OF ANNEALING TEMPERATURE ON THE MECHANICAL PROPERTIES OF CARBON SUPERSATURATED TAW COATINGS

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The combination of ceramic hardness with metallic toughness is a major challenge in the development of protective coatings. The relative new concept of high entropy alloys (HEAs) can be a promising pathway to achieve new high-performance materials While HEA thin films have been studied to some extent by experimental and computational materials science, there is only limited information available about the influence of carbon on HEA thin films, especially when prepared with physical vapor deposition techniques. We have recently studied the properties of CrNbTaTiW thin films and observed a combination of high hardness and crack resistance for Ta and W-rich compositions when small amounts of carbon (< 10 at%) is added [1]. To increase our understanding of the properties of these multicomponent HEA films, we have studied the influence of temperature and carbon on the structure and properties alloys in the ternary TaW-C system. The Ta-W-C thin films were deposited by non-reactive magnetron sputtering from elemental targets. The material properties were strongly depending on the carbon content. The TaW films crystallise in a bcc structure with a strong (110) texture with coherent grain boundaries. TEM analysis revealed that the films exhibit coherent grain boundaries with specific crystallographic directions. The addition of 8 at.% led to the formation of a metastable bcc supersaturated solid-solution without the formation of carbide precipitates. The main effect of the carbon addition was agrain refinement reducing the column width, which resulted in an increase in hardness from 14 to 16 GPa while the reduced E-modulus was unaffected. The enhanced hardness will be discussed in terms of solid solution hardening and grain refinement strengthening. The films were also annealed up to 900 °C to investigate the thermal stability. The TaW(C) remained in the bcc structure and no carbide formation was observed. Furthermore, the annealing had an age-hardening effect leading to a peak hardness of 26 GPa. These results indicate that TaW-C alloys are suitable for future high temperature application.

[1] S. Fritze, P. Malinovskis, L. Riekehr, L. von Fieandt, E. Lewin, U. Jansson, Hard and crack resistant carbon supersaturated refractory multicomponent nanostructured coatings, Sci. Rep. (2018) 1–8.