POC006

Influence of the deposition parameters on the structural evolution and thermo-mechanical properties of HiPIMS sputtered Transition metal carbides coatings

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Transition metal carbides are well known for their outstanding thermal stability, high melting temperature, and excellent mechanical properties. Hence, these so-called ultra-high-temperature ceramics (UHTC) are successfully applied in the aviation and space industry. Depending on the transition metal, the compositional range of the most preferred cubic NaCl structure ranges from TM-$C_{0.6}$ to TM-$C_{1.1}$ or higher. With these variations in elemental composition, also the properties of these materials are modified. Our recent work indicates similar properties and dependencies for magnetron sputtered thin films (TaC_y and HfC_y) [1].
As the deposition of carbon-containing coatings is challenging with respect to chemical and structural evolution, high power impulse magnetron sputtering (HiPIMS) is an interesting approach due to high ionization degrees and hence enhanced surface mobility of arriving species.
Within this work, we successfully deposited Transition metal carbides hard coatings using a pulsed DC, as well as a HiPIMS powered target, in a lab-scaled magnetron sputtering system. We examined them for structural characteristics using x-ray diffraction, studied their mechanical properties, and determined the elemental composition – especially, with respect to the off-stoichiometry. We performed these investigations with regard to a wide variation in deposition parameters such as deposition pressure, duty cycle, as well as peak power density. Furthermore, the thermal stability and oxidation resistance of selected coatings were investigated by a set of high-resolution characterization (HR-TEM, APT, and DSC) techniques.
[1] H. Lasfargues, et al., Non-reactively sputtered ultra-high temperature Hf-C and Ta-C coatings, Surf. Coat. Technol., 309 (2017), 436-444.

Keywords
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