KN1100

Magnetron sputtered hard ceramic coatings with high electrical conductivity and thermal stability in air

Jaroslav Vlcek

University of West Bohemia, Plzen, Czech Republic

vlcek@kfy.zcu.cz

Pulsed dc magnetron co-sputtering of a single segmented target (B_4C-Zr or B_4C-Hf-Si) in Ar gas or Ar-N_2 gas mixtures was used for deposition of different multifunctional coatings. The repetition frequency of pulses was 10 kHz at a fixed 85 μs voltage pulse length and the total pressure of 0.5 Pa. Energy-resolved mass spectroscopy was used to correlate the energy of Ar^+ ions bombarding the growing coatings with high positive voltage overshoots after the negative voltage pulses. We present and discuss the results obtained for nanocolumnar ZrB_2-type Zr-B-C coatings [1], nanocomposite Zr-B-C-N coatings [1,2] and nanostructured HfB_2-type Hf-B-Si-C coatings [3], exhibiting a high hardness of 34-37 GPa and high electrical conductivity (electrical resistivity of 1.7-4.5x10^{-6} Ωm), and for amorphous Hf-B-Si-C-N coatings [4], exhibiting a hardness of 19 GPa, optical transparency (extinction coefficient of 2x10^{-3} at 550 nm up to 1100 °C) and very high oxidation resistance in air even above 1500 °C.

[1] J. Vlček, P. Steidl, J. Kohout, R. Čerstvý, P. Zeman, Š. Prokšová, V. Peřina, Hard nanocrystalline Zr-B-C-N films with high electrical conductivity prepared by pulsed magnetron sputtering, Surf. Coat. Technol. 215 (2013) 186.
[2] M. Zhang, J. Jiang, J. Houška, J. Kohout, J. Vlček, E.I. Meletis, A study of the microstructure evolution of hard Zr-B-C-N films by high-resolution transmission electron microscopy, Acta Mater. 77 (2014) 212.
[3] J. Kohout, J. Vlček, J. Houška, P. Mareš, R. Čerstvý, P. Zeman, M. Zhang, J. Jiang, E.I. Meletis, Š. Zuzjaková, Hard multifunctional Hf-B-Si-C films prepared by pulsed magnetron sputtering, Surf. Coat. Technol. 257 (2014) 301.
[4] P. Zeman, Š. Zuzjaková, P. Mareš, R. Čerstvý, M. Zhang, J.Jiang, E.I. Meletis, J. Vlček, Superior high-temperature oxidation resistance of magnetron sputtered Hf-B-Si-C-N film, Ceram. Int. 42 (2016) 4853.

Keywords
Pulsed magnetron sputtering
Ceramic coatings
Hardness
Electrical conductivity
High-temperature oxidation resistance