Title: Magnetron Sputtering of Al-Cr-O Thin Films at Various Substrate Temperatures

Authors: D. Diechle[1], M. Stueber [2], H. Leiste[2], S. Ulrich[2], V. Schier[1]

[1] Walter AG, Research and Development, PVD Coating, Tübingen, Germany

[2] Karlsruhe Institute of Technology, Institute for Applied Materials, Karlsruhe, Germany

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High performance applications such as protective PVD coatings for metal cutting require outstanding multifunctional properties including high hardness, chemical inertness and high temperature stability to meet the increasing demands for higher productivity. In the past few years the synthesis of hard Al-O and related protective thin films attracted large scientific interest and such coatings were successfully introduced in industrial production processes.

Ternary solid-solution strengthened Al-Cr-O thin films were deposited in a laboratory-scale Leybold Z 550 PVD coater from a segmented Al-Cr target in a reactive Ar-$O_2$-atmosphere by r.f. magnetron sputtering. The cathode power was set to 500 W in r.f. mode in general. The total gas pressure was kept constant at 0.4 Pa in all experiments with a gas flow ratio of 80 % argon and 20 % oxygen. A combinatorial approach led to the growth of Al-Cr-O thin films with (Al+Cr)/O-ratios of approximately 0.67 and Cr/(Al+Cr)-ratios between 0.3 and 0.8. The substrate temperature was kept constant during deposition while it was varied between 200 °C and 500 °C in different experiments. The microstructure of the metastable thin films was characterized by X-Ray diffraction (XRD) in Bragg-Brentano mode, and their Vickers micro hardness was determined.

The paper focuses on the phase analysis, the grain size and the Vickers micro hardness in dependence of the substrate temperatures and the Cr/(Al+Cr)-ratios of the thin films. The evaluation of these results leads to the derivation of a PVD phase diagram of Al-Cr-O thin films for specific Cr/(Al+Cr)-ratios and substrate temperatures.