

In situ study of texture development during the growth of magnetron sputtered VC1-x thin films.

Authors : Sunil Kotapati, Marthe Kaufholz, Bärbel Krause, Stephen Doyle, Miguel Mantilla, Michael Stüber, Sven Ulrich and Tilo Baumbach

Affiliations : Institute for Photon Science and Synchrotron Radiation, Karlsruher Institut für Technologie, Karlsruhe, Germany; ANKA, Karlsruher Institut für Technologie, Karlsruhe, Germany; Max-Planck-Institut für Intelligente Systeme, Stuttgart, Germany ; Institut für Angewandte Materialien – Angewandte Werkstoffphysik (IAM-AWP), Karlsruher Institut für Technologie, Karlsruhe, Germany.

Resume : Transition metal carbides play a major role in the area of hard coatings and tribological applications. In order to obtain the desired properties such as hardness and wear resistance, it is necessary to understand the microstructure formation processes on the atomic and microscopic scale. In situ x-ray diffraction experiments during thin film deposition are a very useful tool to understand the interplay between the microstructure and macroscopic coating properties. The aim of this study is to develop a model for the microstructure formation of hard coatings as a function of different process parameters such as substrate temperature and bias. For this, several vanadium carbide (VC_{1-x}) thin films were deposited at various substrate temperatures (RT-450°C) using DC magnetron sputtering. The powder rings observed during deposition reveal that below a transition temperature (~250°C), a mixture of [111] and [200] textures dominates, while a preferred [111] orientation is found for temperatures above 250°C. A strong [111] texture is observed at higher temperatures (~450°C). The real time measurements also show that there are textural and microstructural changes as a function of deposition time. Strain, stress and crystallite size as a function of substrate temperature were studied as well. AFM was used as a complementary method to analyse the surface morphological changes. The measurements reveal that roughness increases with temperature and sample thickness.