In situ X-ray study of Vanadium Carbide

B. Krause[1], S. Darma[1], T. Baumbach[1], M. Stüber[1], S. Ulrich[2]

[1] Institut für Synchrotronstrahlung, Karlsruher Institut für Technologie (KIT)
[2] Institut für angewandte Materialien, Karlsruher Institut für Technologie (KIT)
baerbel.krause@kit.edu

rf magnetron sputtering is a widely established technique for the deposition of amorphous and nano- and polycrystalline thin films. However, the relationship between synthesis process, the final microstructure of the coating material and the macroscopic material properties is still not well understood.

In situ X-ray methods belong to the few experimental tools compatible with the low-pressure plasma conditions during sputtering [1]. They give insight into the temporal development of the structure (e.g. crystalline phase, crystallite size, orientation and strain), and the morphology of the coating.

We have developed a new sputtering system which combines the possibilities for in situ X-ray studies, systematic studies with complementary UHV analysis methods and the measurement of the plasma parameters. The latter is especially important since the growth process is directly influenced by the plasma parameters, but the dependence of the plasma parameters on the accessible process parameters is difficult to predict [2]. Combining these different methods, an encompassing picture of the microstructure formation at different growth conditions can be formed, which is necessary for the design of new materials, and for the prediction of their macroscopic properties.

Vanadium carbide and titanium carbide based nanocomposite materials such as metastable (V,Al)(N,C) and (Ti,Al)(N,C) are of great technological interest, since their macroscopic properties can be tailored by variation of the microstructure. A wide range of thin film structures can be created, depending on composition and growth parameters [3]. As first step for the systematic study of this group of materials, a growth study on VC has been performed. Here, first results combining in situ grazing incidence X-ray scattering experiments and complementary methods will be presented. The time-dependent development of the microstructure as a function of the growth conditions will be discussed.

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