PO2018

E-beam evaporation vs. rf-sputtering: Comparing the growth behavior, crystallinity, and morphology of heteroepitaxial iridium (001) films on sapphire (11-20)

Frank Meyer[1], Andreas Graff[2], Eduard Reisacher[1], Eva-Regine Carl[1], Sabine Oeser[1], Alexander Fromm[1], Marco Wirth[1], Lukas Groener[1], Frank Burmeister[1]

[1]Fraunhofer IWM, Freiburg, Germany [2]Fraunhofer IMWS, Halle, Germany

frank.meyer@iwm.fraunhofer.de

Many characteristics of the metallic surface i.e. the electronic structure, surface energy, and catalytic activity, strongly depend on the crystallographic orientation. To control and define the crystallographic orientation of a metallic surface is thus important in applications ranging from electronic device fabrication to catalysis. (100)-oriented iridium films are of economic interest for the growth of single crystalline diamond substrates or ferroelectric PZT-films [1]. A possible synthetization route is the heteroepitaxial growth of iridium thin films on single crystal oxides. This is often done by e-beam-evaporation [2] at high substrate temperatures (> 600 C°-800°C) and low deposition rates (< 1nm/min). However, regarding e.g. industrial production processes, an alternative deposition technique with significantly lower substrate temperatures and higher deposition rates would be desirable. When compared to e-beam-evaporation, it is expected that e.g. sputtering allows for an enhanced control of microstructure and intrinsic stresses in the deposited films even at relatively low substrate temperatures but also leads to a higher number of growth defects.
In this study we therefore compared the growth behavior, crystallinity, and morphology of e-beam evaporated iridium films with bias assisted rf-sputtered iridium films. For e-beam-deposition, we varied the substrate temperature and the evaporation rate, for sputtering, we varied also the substrate temperature, the deposition power and working pressure. XRD revealed in both cases a strong preferential (100)-orientation whereas SEM and EBSD-investigations confirmed large (100)-grains with small mosaic spread.
[1] G. Beshenkov, et.al., Technical Physics Letters. 40, 644-647 (2014).
[2] Kee Han Lee et.al., Diamond and Related Materials, 66, 67-76 (2016).
[3] Z. Dai et.al., Appl. Phys. Lett. 82, 3847 (2003).

Keywords
Bias-assisted rf-sputtering
e-beam evaporation
growth behavior