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Effect of substrate bias on the growth behavior of iridium on A-plane sapphire using radio frequency sputtering at low temperatures

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As for many other noble metals, the electronic structure, surface energy, and catalytic activity of the iridium surface strongly depend on its crystallographic orientation. However, it is often elaborate and expensive to manufacture single crystal surfaces with specified crystallographic orientations. One approach to overcome this problem is the heteroepitaxial growth of metal films on dielectric substrates. The heteroepitaxial growth of such films usually requires deposition conditions close to the thermodynamic equilibrium, i.e. deposition at high substrate temperatures and very low deposition rates [1,2].
In this study we present results on the investigation of the substrate bias effect on the growth behavior of iridium films deposited on A-plane sapphire by radio frequency (rf) sputtering at low substrate temperatures. Iridium thin films deposited without substrate bias were compared to films deposited with simultaneous application of a second rf-plasma on the substrate. The morphology, crystallinity, and crystallographic orientation of the resulting films were characterized by scanning electron microscopy, X-ray diffraction, and electron backscattering diffraction. We find that the application of an additional substrate bias leads to the generation of ordered nuclei with preferential crystallographic orientation and thus strongly affects the growth behavior of iridium (001) on sapphire (11-20). In this way, the fabrication of well-ordered thin films of Ir with large (100)-domains becomes feasible even at high deposition rates and at substrate temperatures as low as 350 °C [3].
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