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Deposition of Highly Coordinated MgO Films by CVD Operated Under Atmosphere

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【Background】

Chemical Vapor Deposition (CVD) operated under atmosphere is a thin film deposition technique where a metal-complex precursor is vaporized and deposited upon a suitably heated substrate; it is ideal for the synthesis of oxides like Magnesium Oxide (MgO), which is known to possess great mechanical resistance and thermal stability[1)]. However, when exposed to humidity, the free bonds in MgO admit water molecules into its structure resulting in the formation of magnesium hydroxide $Mg(OH)_2$, followed by a large volumetric expansion[2)]. This hydration process is known to be hindered in highly coordinated crystals as the sites available for water adsorption decrease[3)]. In this study we aimed the synthesis of highly coordinated MgO (100) crystals by the CVD operated under atmosphere technique.

【Experimental】

MgO was deposited on 10x10x0.5 mm^3 MgO (100) single crystal substrates heated at 650 ℃. The precursor Magnesium Acetylacetonate was heated to 230 ℃ in the sublimation chamber. The vapor was then transported by N_2 gas preheated at 230 ℃, at a constant flow rate of 1.5 l/min. The nozzle, 15 mm away from the substrate, was set to 240 ℃. The precursor is released into the atmosphere upon the substrate to form MgO by chemically reacting with the oxygen in the air. Samples were deposited 6.4, 32 and 64 hours. Crystalline properties and epitaxial relationship of substrate and samples were confirmed by X-Ray diffraction, rocking curves and pole figures using a RAD No. 2038, Rigaku diffractometer.

【Results and Discussion】

After deposition the 2θ-XRD showed a strong diffraction line on the position of the MgO (200) peak (42.9 deg). The in-plane orientation of the substrate and the deposited samples were confirmed by pole figures, showing 4 symmetric poles separated 90 degrees in the 2θ value. This indicates a symmetric growth with an in-plane cubic (100) orientation. Rocking curves taken for the substrate and samples are shown in Fig. 1. The FHMW for the substrate was 0.181 deg, 0.095 deg for the 6.4 hours, 0.086 for the 32 hours, and 0.076 for the 64 hours samples. This narrowing of the rocking curve peak and the higher angle shift suggest the lattice parameter is decreasing due to the elimination of defects and a higher coordination of the grown crystals.

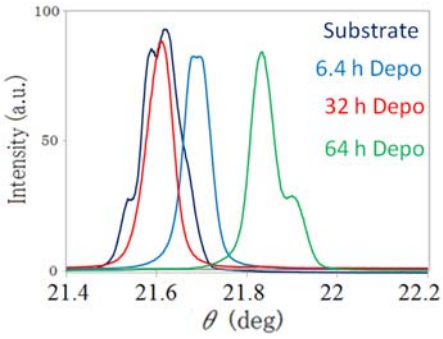

Fig. 1 Rocking Curve for MgO/MgO(100)

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