Synthesis and electrode reaction of epitaxial perovskite thin-films deposited on YSZ substrate

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It is well known that electrode reaction in SOFC proceeds at three-phase boundary in practical porous electrodes. The electrode reaction at the boundary is rather complex, and the reaction process is difficult to clarify in the porous electrode system. However, it is important to disintegrate the whole electrode reaction into successive single processes and estimate the speed of individual ones. Single crystal thin film is an ideal electrode with solid/gas interface and may provide ideal electrode reaction process in SOFC. In the present study, the epitaxial thin-films were successfully deposited on the single crystal substrate of yttria stabilized zirconia (YSZ). The electrode process was studied using the ideal two-dimensional electrode.

$La_{0.8}Sr_{0.2}CoO_3$ (LSC) thin films were prepared by pulsed laser deposition method (PLD). La_2O_3, $SrCO_3$ and Co_3O_4 used as starting materials were weighed, mixed and sintered at 1000˚C for 10 h before heating at 1300˚C for 24 h. The pellet obtained was used as a target for PLD. The deposition was performed using KrF excimer laser with 100~300 mJ / pulse power. The substrate temperatures of 600~800˚C were used during the deposition. X-ray diffraction measurements were performed to characterize these thin-films.

Fig. 1 shows X-ray diffraction patterns of the LSC thin film deposited on YSZ (100) and (110). Weak reflections near 33˚ and 70˚ were observed close to the YSZ peak, and these reflections were indexed as 110 and 220, respectively, based on the cubic perovskite lattice.

Fig. 2 shows X-ray diffraction patterns of the LSC films deposited on YSZ (111), and Fig. 3 shows deposition-time dependence of the lattice parameters for these films. The reflection indexed as 110 with a cubic cell shifts to lower angles with the deposition time.

Fig. 4 shows the reciprocal lattice map obtained by in-plane measurement along the 0-22 direction in YSZ. The sharp spot near 45˚ was indexed as 00-2, indicating epitaxial growth and good crystallinity. The relationship between the deposition conditions, crystal structures, and electrode reactions in these LSC films will be discussed.

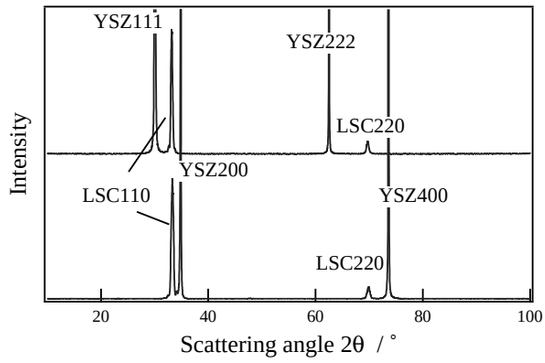

Fig.1 X-ray diffraction patterns for LSC films deposited on YSZ(100), (111).

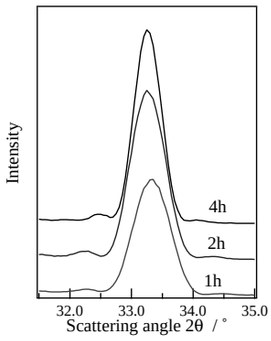

Fig.2 X-ray diffraction patterns for LSC film deposited for 1,2 and 4h.

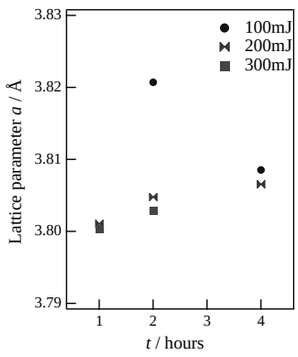

Fig.3 Deposition time dependence of lattice parameters for LSC films.

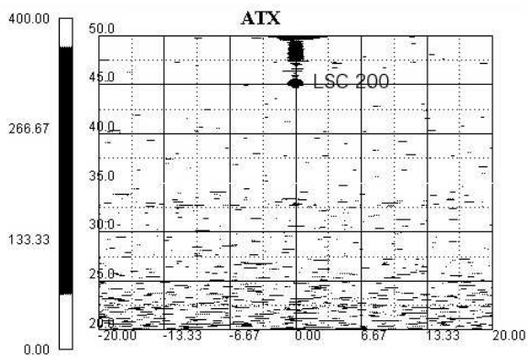

Fig.4 Reciprocal lattice map for LSC film deposit on YSZ (111).