

Preparation of Functional Complex Oxide Films  
by Hydrothermal-electrochemical Method

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A new technique called "hydrothermal-electrochemical method" has been developed, which could be categorized into a variety of extended hydrothermal methods. The technique provides an easy fabrication of well-crystallized polycrystalline thin films of perovskite-type compounds at very low temperatures.

Application of the hydrothermal-electrochemical method is demonstrated on the thin film preparation of polycrystalline compounds, such as  $\text{BaTiO}_3$ ,  $\text{SrTiO}_3$ , etc., on the Ti-metal substrate or the titanium deposited glass substrate. Titanium metal substrate or Ti-sputtered glass substrate was used for the anode and a Pt plate for the cathode.

The reaction was carried out galvanostatically with an applied current density up to  $25 \text{ mA/cm}^2$  in  $\text{Ba(OH)}_2$  or  $\text{Sr(OH)}_2$  electrolytic solutions (0.1 to 5N) between room temperature and  $200^\circ\text{C}$  under the saturated vapor pressures of solutions in an electrolytic autoclave. The film prepared was lustrous, dense and free from any visible defects. The thickness of the film for  $\text{BaTiO}_3$  increased from 70 nm to 300 nm with treatment time from 10 to 60 min at  $200^\circ\text{C}$  in 0.5N- $\text{Ba(OH)}_2$  solution with the current density of  $15 \text{ mA/cm}^2$ . Capacitance measurements have yielded a dielectric constant of 300. The adhesion between the film prepared and the substrate was so strong that no exfoliation was observed.

The author also has succeeded in fabricating complex oxide films of  $\text{BaFeO}_{3-x}$  on Fe and  $\text{LiNbO}_3$  on Nb by the same method, and  $\text{BaTiO}_3$  and  $\text{SrTiO}_3$  on the polyphenylene sulfide (PPS) polymer film by the hydrothermal method without using the electrolytic process.