Microstructure of $BaTiO_3$ and $SrTiO_3$ layers obtained by injection MOCVD

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Abstract. $BaTiO_3$ (BTO) and $SrTiO_3$ (STO) layers were deposited by injection MOCVD using both a mixed Ba_2Ti_2 precursor (dissolved in hexane) and a $Sr(thd)_2$, $Ba(thd)_2$ and $Ti(OPr^i)_2(thd)_2$ precursor system (dissolved in monoglyme). Films have been deposited at different temperatures between 600°C and 850°C. The microstructural properties of the films obtained on different kinds of substrates MgO (100), $LaAlO_3$ (012), sapphire (1-102), Si (100), Pt on Si and $YBa_2Cu_3O_7$ (YBCO) on $LaAlO_3$ are compared.

1. INTRODUCTION

Sintered barium titanate and strontium titanate ceramics are the most widely used electronic ceramics. Recently, thin films of these materials have been recognized to be useful for electronic and optoelectronic applications because of their large dielectric constants and opto-electronic coefficients. The deposition techniques employed include molecular-beam epitaxy [1], evaporation [2], sputtering [3], metalorganic deposition [4], sol-gel [5], and chemical vapor deposition [6]. Besides these techniques, metalorganic chemical vapor deposition (MOCVD) is very promising for the eventual commercial production of films because of its high deposition rates, its ease of compositional control, and its ability to cover nonplanar shapes as well as to deposit high quality films with low defect densities.

In this letter, we report on the *in situ* epitaxial growth of $BaTiO_3$ and $SrTiO_3$ thin films on different kinds of substrates by injection MOCVD at substrate temperatures between 600°C and 850°C.

2. EXPERIMENTAL

The deposition was performed in a low-pressure injection MOCVD system described elsewhere [7]. Shortly, the precursor solution is contained in a hermetically closed vessel, pressurized under 1.5 bar of argon and connected to the injector, which is a high speed electro valve. The injector itself is close to a furnace situated inside the reactor (evaporator held at 250-300°C). In our set of experiments, the reactor pressure being kept at 5-7 Torr, the droplets injected (precursor+solvent) are flash volatilized. A vector gas, flowing along the neck of the injector, ensures the transport of the vapours towards the heated substrate where deposition takes place.

Growth conditions are summarized in table I.

Table I. Summary of growth conditions

Substrate temperature	600°C - 850°C
Reactor pressure	5 - 7 Torr
Flow rate of Ar	40 - 500 sccm/min
Flow rate of O_2	140 - 500 sccm/min
Frequency of precursor solution delivery	1Hz
Concentration of solution	0.013M (in hexane) /. 0.017 - 0.07M (in monoglyme)
Size of droplets	around 4 µl
Deposition time	10 - 15 min
Growth rate	about 1 µm/h