Tungsten-Bronze $Ba_2NaNb_5O_{15}$ and Layer-Structured $Bi_4Ti_3O_{12}$ Ferroelectric Thin Films

Yoichiro MASUDA*[1], Hiroshi MASUMOTO*[2], Akira BABA*[1],
Takashi GOTO*[2], AND Toshio HIRAI*[2]

Abstract

Polycrystalline and epitaxial films of a layer-structured ferroelectric $Bi_4Ti_3O_{12}$ (BIT) in perovskite phase and tungsten-bronze typed $Ba_2NaNb_5O_{15}$ (BNN) have been deposited on sapphire and alumina substrates by ECR plasma and RF magnetron sputtering using a sintered ceramic target. The substrate temperature higher than 550℃ was necessary to grow BIT films in the perovskite phase without post thermal annealing. BIT films were epitaxially grown on C, A and R surfaces of a sapphire single crystal. The deposition ratio of BNN film (Ba : Na : Nb) depended on the sputtering gas pressure. The dielectric, ferroelectric and optical properties of these films are discussed.

INTRODUCTION

Recently, considerable attention has been centered on the development in film technologies of ferroelectric materials for many useful electronic and optical devices such as optical memory, display, non-linear, DRAM and nonvolatile memory devices (FRAM), because these materials have excellent dielectric, piezoelectric and optical properties. Presently, several attempts have been made to form layer structured ferroelectric $Bi_4Ti_3O_{12}$ (BIT) and tungsten bronze typed ferroelectric $Ba_2NaNb_5O_{15}$ (BNN) thin films by ECR and RF planar magnetron sputtering using a ceramic target. So far many electrical properties of the modified hot-forging BIT ceramics have been mainly studied.[1)] It is known that RF sputtering enables the epitaxial growth of BIT film on single crystalline MgO substrates and the preferred orientation is c-axis on Si substrates[2,3,4)]. The present paper describes the epitaxial growth of BIT films on sapphire substrates by the ECR plasma sputtering, deposition of BNN films on Pt/Al_2O_3 substrates by the RF magnetron sputtering method and dielectric, ferroelectric, optical and crystallographic properties.

EXPERIMENTAL PROCEDURE

An electron cyclotron resonance (ECR) plasma sputtering apparatus (Sumitomo Metal

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*1 八戸工業大学　教授
*1 八戸工業大学電気工学科　技師補
*2 東北大学金属材料研究所　助手
*2 東北大学金属材料研究所　助教授
*2 東北大学金属材料研究所　教授