Synthesis and Microwave Dielectric Properties of $Ce(Nb_{1-x}Ta_x)TiO_6$ Solid Solutions

Takeshi Oishi, Hirotaka Ogawa, Akinori Kan and Hitoshi Ohsato[1]

Faculty of Science and Technology, Meijo University, 1-501 Shiogamaguchi, Tempaku-ku, Nagoya 468-8502, Japan
[1]Department of Materials Science and Engineering, Nagoya Institute of Technology, Gokiso-cho, Showa-ku, Nagoya 466-8555, Japan

The rapid growth of the mobile and satellite communication industry has been created a high demand for microwave ceramic components. The microwave dielectric ceramics which have a high dielectric constant (ε_r), a high quality factor ($Q \times f$) and a near zero temperature coefficient of resonant frequency (τ_f) are used for the dielectric resonator. Recently, the microwave dielectric properties of $CeNbTiO_6$ ceramic were reported and it was found that the dielectric constant of the ceramic is comparable to that of $Ba_2Ti_9O_{20}$ ceramic that is widely used for the dielectric resonator in the base station.

The samples of the $Ce(Nb_{1-x}Ta_x)TiO_6$ solid solutions were prepared from high purity (>99.9%) CeO_2, Nb_2O_5, Ta_2O_5 and TiO_2 powders, using a solid-state reaction method. The identification of synthesized phase and the refinements of lattice parameters were performed by using X-ray powder diffraction (XRPD), and the microwave dielectric properties were evaluated in terms of the Hakki and Coleman's method. The microstructures of the samples were observed by means of scanning electron microscopy.

From the XRPD patterns, the single phase that corresponded to the aeschynite type structure was obtained over the whole composition range. The dielectric constants and the quality factors of the solid solutions range from 48.0 to 33.5 and from 10798 to 14128 GHz, respectively. The temperature coefficients of resonant frequency of the solid solution varied from 86.7 to 53.1 ppm/□. These values were slightly improved, depending on the increase in the composition x.