

of the coating solution was significantly improved by the addition of acetylacetone. BLT thin films were prepared on Pt(200 nm)/TiO₂(50 nm)/SiO₂/Si substrates by a spin-coating technique from alkoxide precursor solutions of BLT. As-deposited precursor films were dried at 150°C for 5 min, and then were irradiated using an Xe excimer UV lamp (172 nm) at 300°C for 30 min in O₂ atmosphere. The excimer UV-processed films were calcined at 500°C for 10 min in an O₂ atmosphere, and then were annealed at 550–700°C for 30 min in an O₂ atmosphere by RTA. The film thickness of BLT was adjusted to approximately 200 nm by repeating the coating/calcining cycles four times.

Optical properties of BLT precursor solution irradiated using a UV lamp (Ushio Electrics, UXM-501MD: 210–580 nm) were evaluated using a UV-V spectrometer. The crystallinity and crystalline phase of BLT thin films were examined by X-ray diffraction (XRD). The surface morphology of the thin films was observed using an atomic force microscope (AFM) and a field-emission scanning electron microscope (FE-SEM). The chemical species in the excimer UV-processed thin films were analyzed by a Fourier transform infrared spectrometer (FT-IR).

Prior to electrical measurements, circular Pt electrodes of 0.20 mm diameter were deposited by rf sputtering onto the surface of the films, which was followed by annealing at crystallization temperatures for 5 min. The ferroelectric properties of the films were also evaluated by means of a ferroelectric test system (TFA-ANALYZER 2000, AixACCT. Inc.) at 100 Hz. The applied voltage was 1–15 V.

3. Results and Discussion

3.1 Optical properties of BLT precursor solutions

In order to investigate the change of BLT precursor solution after UV irradiation, optical properties of the BLT precursor solution were evaluated using a UV-V spectrometer. Figure 2 shows the UV-V spectra of BLT precursor solutions irradiated using a UV lamp at room temperature for 30–60 min in N₂. At the stage of UV-nonirradiation, the BLT precursor solution showed a high transmittance over a wide wavelength

region, as shown in Fig. 2(a). On the other hand, in the UV-irradiation time of 30 to 60 min, the transmittance decreased from approximately 65 to 40% at 500 nm, as shown in Fig. 2(b) and (c). This may be due to the dissociation of organic species, followed by the generation of organic radical and reduced Ti ion in the BLT precursor solution by the photolysis reaction. Hunt and Winter⁹ have reported the photoinduced reduction of Ti(IV) to Ti(III) alkoxides by sunlight. Therefore, Ti(IV) in the BLT precursor is reduced to Ti(III) by UV light. Due to the change in optical property of the BLT precursor solutions, UV irradiation is found to influence the chemical bonding between metal ion and organic ligands. Hence, in this work, excimer UV light (172 nm) with a high energy was employed to remove the organic species smoothly from the precursor films during the fabrication process of BLT films.

3.2 FT-IR spectra of excimer UV-irradiated BLT precursor thin films

Figure 3 shows FT-IR spectra of as-deposited BLT thin films irradiated using an excimer UV lamp at 300°C for 30 min in O₂ atmosphere. The absorbance peak assigned to stretching vibrations of C–H groups was observed at approximately 2900 cm⁻¹ for the samples calcined at 300°C without irradiation. However, at the excimer irradiation temperature of 300°C in O₂ atmosphere, the organic species in precursor gel films were completely removed during the irradiation time of 30 min. This may be attributable to the easier decomposition of organic groups by an oxidation reaction in O₂ atmosphere as well as the bond cleavage by the photolysis reaction.

3.3 Crystallization of BLT thin films

The crystallinity of BLT films was examined by changing the composition of the films. BLT thin films with Bi-excess, Bi_{3.35}La_{0.75}Ti₃O₁₂, exhibited a higher crystallinity than those with a stoichiometric composition of Bi_{3.25}La_{0.75}Ti₃O₁₂, as shown in Fig. 4.

Figure 5 shows XRD patterns of Bi_{3.35}La_{0.75}Ti₃O₁₂ thin films without and with excimer UV irradiation at 300°C for 30 min in an O₂ atmosphere, followed by RTA at 550 and 600°C for 30 min. As-deposited thin films without excimer UV-irradiation crystallized at 550°C and exhibited random orientation with a weak (00 l) diffraction peak, as shown in Fig. 5(a). On the other hand, excimer UV-processed thin films

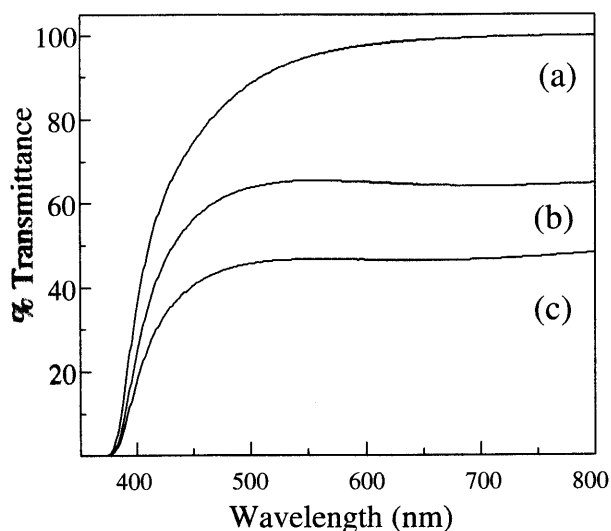


Fig. 2. UV-V spectra of BLT precursor solutions with acacH (a) before UV irradiation and after irradiation for 15 min (b) and for 30 min (c).

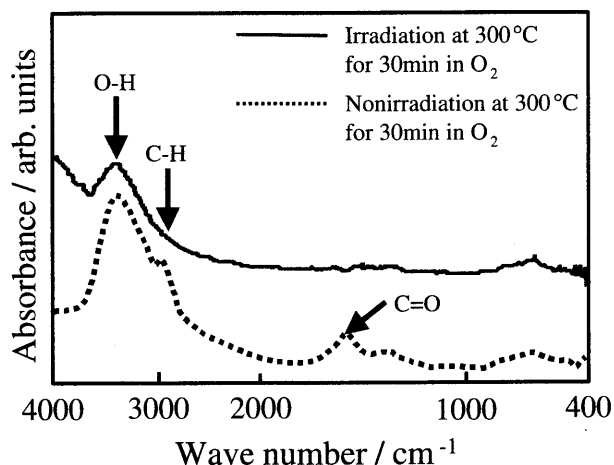


Fig. 3. FT-IR spectra of as-deposited BLT gel thin films without and with excimer UV irradiation at 300°C for 30 min in O₂ atmosphere.