空気中の BiI_3 の酸化による BiOI 膜のワンポット無溶媒合成

One-pot solvent free synthesis of BiOI films via oxidation of BiI_3 in air

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Introduction

Bismuth oxyiodide (BiOI) is the promising bismuth-based materials which has been applied as photocatalyst in waste treatment[1]. Since it has good absorption under visible spectral range, BiOI can be used as the component in photovoltaic devices[3],[4]. It was informed that BiOI can be a future material in photovoltaic and competing with the Pb-based perovskite material due to its stability[3]. Nowadays, various BiOI films have been successfully synthesized by dip-coating method via successive ionic layer adsorption and reaction (SILAR) and chemical bath deposition (CBD). While BiOI powder also could be obtained from direct annealing of BiI_3[4], it is also possible to prepare the BiOI films by this BiI_3 powder oxidation. The direct annealing of BiI_3 is preferable for our BiOI preparation since it does need the solvent usage. Therefore, it can minimize the waste. Some properties on the prepared BiOI films by BiI_3 oxidation will be studied in this work.

Materials and Methods

0.1 gram of BiI_3 was placed in the petri dish and it was vaporized in air at 360 ^oC. The different vaporization time in BiI_3 was varied from 45 to 150 minutes. The cleaned glass substrate was set on top of the petri dish. From this vapor deposition, the deposited BiI_3 in glass substrates could be obtained. Then, the deposited BiI_3 was annealed at 350 ^oC for 1 h to result in the BiOI layer. To study the structural property, all films were characterized by X-Ray diffraction (XRD) and Raman spectrophotometer. To evaluate the optical character and its morphology, the analysis using UV-Visible spectrophotometer and FESEM were also required.

Results and Discussion

As the deposition time increased, it resulted in the increase in the film thickness. The more time in deposition step allowed the more deposited BiI_3 onto glass substrates which could reduce the noise of glass substrate patterns in displayed XRD patterns (Figure 1). The crystal planes (001); (002); (102); (110); (004); (200); and (122) were confirmed at 2θ around 9.6^o; 19.3^o; 29.8^o; 31.86^o; 39.2^o; 45.8^o; and 55^o in annealed BiI_3 for more than 90 min. However, only three basic crystal planes appeared in the annealed BiI_3 for 45 min, namely (001); (102); and (110). We did not find the BiI_3 residue and BiOI derivations peaks in our diffractogram. By the difference in the thickness and crystal planes composition, those BiOI films may show the different optical and photovoltaic properties.

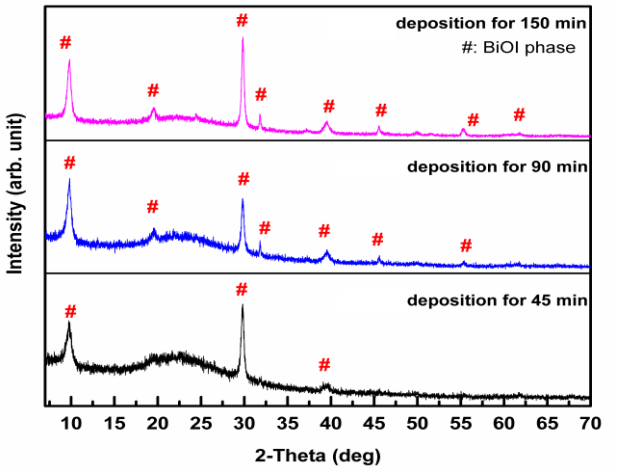

Fig.1 XRD patterns of prepared BiOI films by different deposition time

Conclusions

The deposition time of BiI_3 had the effect on the amount of the deposited BiOI onto glass substrates. Due to the different amount of the deposited material, the film thickness changed. This changing also gave the impact on its structural property, especially in the crystal plane composition. It may also change other characters, like its optical and other behaviors.

References

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