The thickness effect on the BiOI thin films prepared by SILAR

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Introduction:

This study is reporting about thickness effect on the BiOI thin film structure, morphology, crystallite, and optical properties. Here, BiOI thin films have prepared by using SILAR [1] and with the increase of cycle number the thickness of the BiOI films has increased. BiOI is a very attractive material for the researcher because it is safe, less toxic, and stable. It has promising optical property as well. However, to upgrade its poor electrical properties further, more research work is needed [1]. Meanwhile, with the increase of film morphology and uniformity, it is possible to improve the electrical properties. Aiming to improve, the performance analysis of various parameters is still going on. That is why in this research work SILAR cycle effect on BiOI thin morphology has been observed.

Experimental process and Characterization:

To analyse the optical properties, structure and morphology of BiOI thin films, BiOI was deposited on the top FTO and glass by the dip-SILAR process. To complete one SILAR cycle, FTO or glass initially was dipped into 6mM solution of Bi $(NO_3)_3.5H_2O$ and KI respectively then once cleaned with deionized water. By this way we prepared samples for 10cycle, 20cycle, 30cycle and 35cycle. Then annealed with 100^0C for 1hour. Structural characterization, morphology, optical properties and film thickness measurement were performed by XRD system (Rigaku Smartlab XRD), scanning electron microscopy (SEM, JSM-6510) and double beam spectrophotometer (JASCO V-570) and film thickness measured by Dektak 150 Surface profiler Measurement (Dektak 150) respectively.

Result and Discussion:

Our study shows, the color of the sample changes from light yellowish to deep orange with the change of cycle numbers, which has been confirmed from Fig. 1(b). Moreover, the planes (102), (110), and (200) exist in 2θ at, 29.7°, 31.7°, and 45.5° with different intensities which have shown in Fig. 1 (a). Again, it showed that the growth of (200) and (110) planes happen with higher intensity after 30 cycle and 20 cycle respectively. Whereas the intensity of the (102) plane and crystallite size (7.64nm to 10.19nm) increases with cycle number. However, optical band gap and decreases from 1.97eV to 1.84eV. Moreover, dislocation density which is the length of dislocation lines per unit volume decreases from 1.71 to 0.91(lin m)$^{-2}$ ×10^{16}. As a result of that film point defects reduces as well. Again, we measured the film thickness 80nm for 10 cycles, 225 nm for 20 cycles, 500 nm for 30 cycles, 625 nm for 35 cycles, respectively.

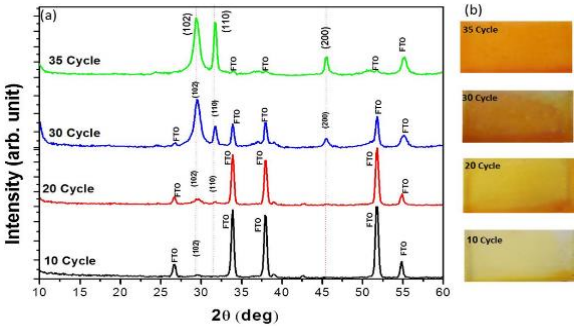

Fig. 1 (a) XRD pattern and (b) Digital photographs of the sample under cycle for the BiOI thin films.

On the other hand with the increase of SILAR cycle flakes density of BiOI thin film increases and any part of the FTO is not visible at higher cycle number which confirmed from Fig.2.

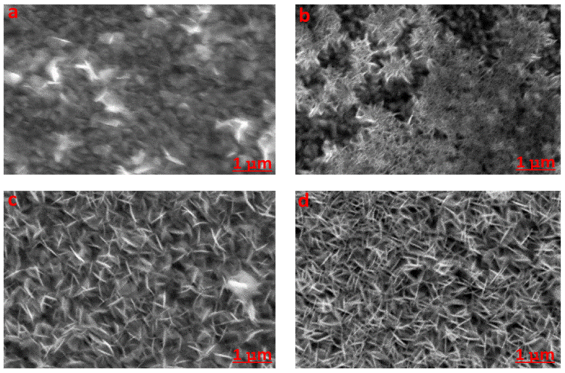

Fig. 2 SEM images for the BiOI thin films: (a) 10 Cycle, (b) 20 cycle (c) 30 cycle and (d) 35 cycles.

Conclusion:

It can be concluded that at 30 SILAR cycle and above that we are getting all (102), (110) and (200) planes. Moreover, with the increase of cycle number crystallite size and film thickness increases but dislocation density and optical band gap decreases.

References:

[1] A. A. Putri, S. Kato, N. Kishi, and T. Soga, "Journal of Science : Advanced Materials and Devices Relevance of precursor molarity in the prepared bismuth oxyiodide films by successive ionic layer adsorption and reaction for solar cell application," J. Sci. Adv. Mater. Devices, no. vol 4, pp. 116–124, 2019.