The growth of superlattice IGZO thin films using ZnO buffer layer grown by thermal atomic layer deposition

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초록

Single-crystal InGaZnO (IGZO) thin films were spontaneously formed as periodic layered structure along the c-axis by thermal treatment at high temperature. when the IGZO superlattice were synthesized by sol-gel method, the effects of preferred growth orientations and the flatness of ZnO buffer layer were investigated. $InGaO_3(ZnO)_2$ superlattice were favorably formed on ZnO buffer layer with single preferred orientation. Futhermore, it showed relatively high Seebeck coefficient and power factor.

1. 서론

BiTe-based materials such as $(Sb_xBi_{1-x})_2Te_3$ and $Bi_2(Te_{1-x}Se_x)_3$ have been developed for the thermoelectric devices of n-type and p-type applied on 200 ~ 400K, respectively. Compared to conventional Bi-based compounds, oxide thermo-electric materials have been researched for thermoelectric devices at high temperature due to high chemical and thermal stability as well as non-toxic elements. Nomura et al. showed that single-crystal InGaZnO(IGZO) thin films were spontaneously formed as periodic layered structure along the c-axis by thermal treatment at high temperature (1400℃) [1]. $InGaO_3(ZnO)_m$ single crystal consists of alternately stacked InO^{2-} and $GaO(ZnO)_m^+$ layers acts as electron conduction path and barrier layer, respectively.

2. 본론

In previous study, we identified the ZnO buffer layer is necessary to form the IGZO superlattice due to reducing lattice mismatch between IGZO and c-sapphire [2]. We can easily control the growth orientation of the ZnO film with only changing the growth temperature by atomic layer deposition (ALD) process. In this survey, the effects of preferred growth orientations and the flatness of ZnO buffer layer for the growth of IGZO superlattice were investigated. The ZnO layer with 50 nm thickness were grown as buffer layers on c-sapphire substrate under different growth temperature by thermal ALD. Amorphous IGZO layer was coated by sol-gel method and post-annealed at 900° C for 9 hours. Crystallinity of thin film was analyzed by X-ray diffraction. Thermoelectric properties such as electrical conductivity, Seebeck coefficient and power factor were evaluated.

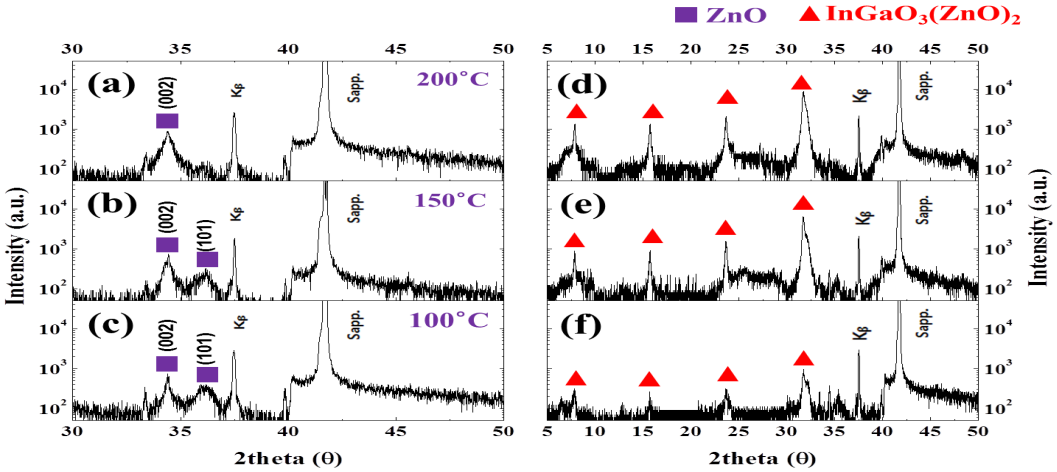

Fig. 1. XRD peak of ZnO buffer layers (a-c) grown on different growth temperature and $InGaO_3(ZnO)_2$ superlattice (d-f) using each ZnO buffer layer

3. 결론

We confirmed that $InGaO_3(ZnO)_2$ superlattice were favorably formed on ZnO buffer layer with (002) single preferred orientation grown on 200℃. $InGaO_3(ZnO)_2$ superlattice using ZnO buffer layer grown on 200℃ showed relatively high Seebeck coefficient and power factor.

참고문헌

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[2] D. K. Seo, B. H. Kong, H. K. Cho, Cryst. Growth & Des., 10 (2010) 4638-4641