Epitaxial $BaTiO_3$ on β-Ga_2O_3 (100)

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Abstract

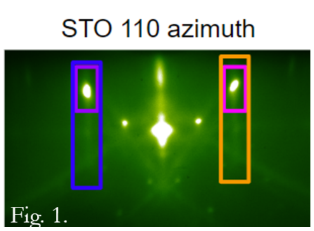
Studies have shown that Gallium oxide has a very high bandgap(4.9ev) and a high voltage breakdown, which can be useful in creating smaller devices compared to silicon following the billiga figure of merit. When epitaxial Barium titanate (which has a high dielectric constant) is grown on β-Ga_2O_3, the dielectric properties improves the breakdown electric field.

Introduction

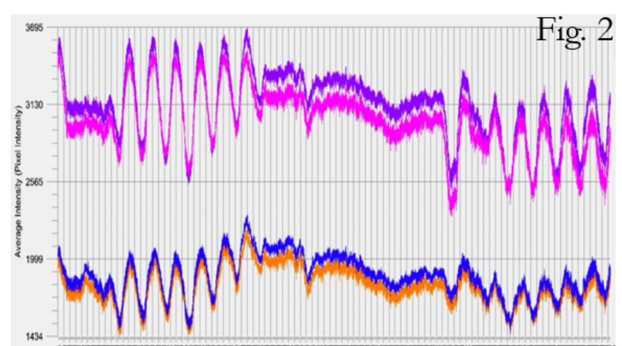
A study shown β-Ga_2O_3 grown on $SrTiO_3$ (100) substrates by MOCVD have shown promising characteristics of pure β-Ga2O3 with excellent crystalline quality. With XRD, HRTEM and SAED analysis confirming that the epitaxial relationships of the sample were β-Ga2O3 (100) | | STO (100) with β-Ga2O3 [010] | | STO < 011 > [1]. In comparison another group in Ohio conducted a similar study where they grew amorphous $BaTiO_3$ on Ga_2O_3 successfully. Where the heterojunction diode has a breakdown electric field of 5.7 MV/cm[2]. $BaTiO_3$ similarly to $SrTiO_3$ is a perovskite, therefore likely to have similar results with Ga_2O_3.

Methods

With Molecular Beam Epitaxy, we calibrated $BaTiO_3$ via RHEED Oscillations on STO (substrate) 110. We used the parameters T_c=700C and P_{o_3}=5E-7 torr for STO.



To obtain a 1 to 1 ratio (stoichiometry) of BTO we measure the average intensity of the points in fig. 1 from peak to peak or trough to trough (fig.2). It's important to keep a 1 to 1 ratio as we dont want the sample to become barium rich if it begins to treds upward, or titanium rich if it begins to trend downwards. We confirm these calculations with Rheed and XRD.



Results

With XRD we confirmed we grew Epitaxial $BaTiO_3$ grown on β-Ga_2O_3 (shown in fig. 3&4). The fringes on the BTO peak in fig. 4 correspond to the RHEED pattern in fig. 5 and indicate crystalline quality at these varying temperatures as the patterns had flat surfaces with small domains.

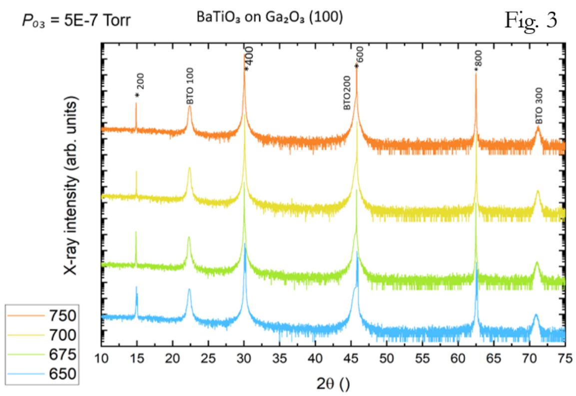


Fig. 3

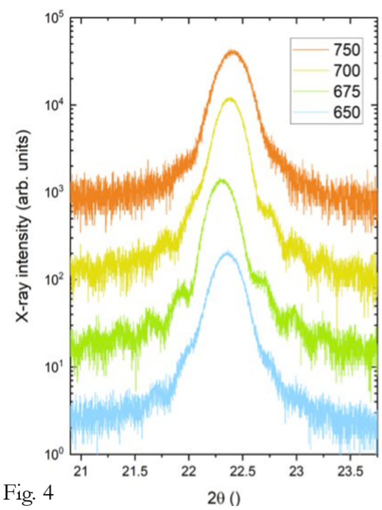


Fig. 4

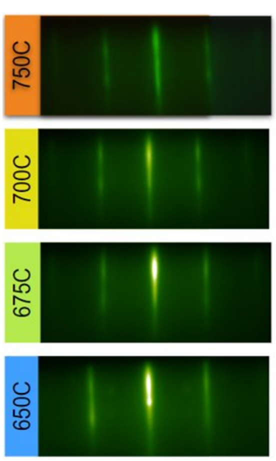


Fig. 5

Conclusions & Future Work

We Grew epitaxial BaTiO3 on β-Ga2O3 (100) and It was Confirmed by RHEED and XRD. We look forward to Confirming the quality of the samples with TEM measurements and Grow device quality films : BaTiO3 / β-Ga2O3 (100) and measure the breakdown electric field

Acknowledgements

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References

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[2]Z.X, H.C, W.M, C.W, A.L, J.M, N.K.K, A.A, S.R, F.Y, S.R. *Metal/BaTiO3/β-Ga2O3 Dielectric Heterojunction Diode with 5.7 MV/cm Breakdown Field*