Electronic Transport and Breakdown Phenomena
Room Bansal Atrium - Session ET-MoP

Electronic Transport and Breakdown Phenomena Poster Session

ET-MoP-2 Temperature Dependence of Bandgap and Anisotropy in Urbach Tail in β- Ga_2O_3, ***Ariful Islam**, N. Rock, M. Scarpulla,* University of Utah

Gallium oxide (Ga_2O_3) has an extremely wide bandgap, predicted high breakdown field, and can be produced from melt crystal growth techniques making it attractive for next-generation high-power electronics. It is well-known that the optical transitions in monoclinic β-Ga_2O_3 are anisotropic; the threshold energies for carrier generation using linearly polarized light depend on crystallographic direction. Using transmission optical spectroscopy, which probes subtly differently than e.g. ellipsometry, we have investigated the optical transitions of Fe doped [100] β-Ga_2O_3 as function of elevated temperature and have documented the dramatic bandgap narrowing with temperature which was recently explained using density functional theory [1]. Here we also report on the anisotropy and doping dependencies of the disorder-induced Urbach tails in the optical absorption coefficient for β-Ga_2O_3. Band tails in semiconductors depend on both static disorder and the dynamic disorder induced by phonons mediated by the electron-phonon coupling. Given the low symmetry of β-Ga_2O_3 and its strong electron-phonon coupling, we predicted that the Urbach tails should also exhibit significant anisotropy. However, at low liquid nitrogen temperature (77K) the anisotropy of the Urbach tail is insignificant and almost overlaps in different crystallographic directions.

We show that this is indeed the case of room temperature and liquid nitrogen temperature and also provide results for Fe-doped and Sn-doped crystals, both of which exhibit large anisotropic band tails as expected at room temperature, and the anisotropy of the band tails significantly reduced at liquid nitrogen temperature.

References

[1]. Lee, C., Rock, N.D., Islam, A., Scarpulla, M.A. and Ertekin, E., 2023. Electron–phonon effects and temperature-dependence of the electronic structure of monoclinic β-Ga2O3. *APL Materials*, *11*(1), p.011106.

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