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Defect States in the Wide Gap Semiconductor Ga2O3 TRACY LOVEJOY, S. ZHENG, E.N. YITAMBEN, A. PAKHOMOV, F.S. OHUCHI, M.A. OLMSTEAD, Univ. of Washington, E.G. VILLORA, K. SHIMAMURA, Y. YAMASHITA, H. YOSHIKAWA, S. UEDA, I. PIS, K. KOBAYASHI, NIMS, S. VAITHIYALINGAM, PNNL — Ga2O3 is a transparent wide gap semiconducting oxide with potential applications as a transparent conductive oxide (TCO). The mechanism for conductivity in this material is under debate. The long established picture involves conduction by oxygen vacancy defect states, but a recent paper [Appl. Phys. Lett. 92 202120 (2008)] shows the conductivity can be intentionally controlled over three orders of magnitude by silicon doping on the order of typical Si impurity levels in Ga2O3 source materials. In light of this, the actual role of oxygen vacancies is unclear. We illuminate this issue by measuring the conductivity in single crystals of beta-Ga2O3 as a function of annealing in vacuum. Contrary to expectation, high vacuum annealing causes an order of magnitude decrease in conductivity, but only along the open channel direction in the crystal. As neither Si impurity nor oxygen vacancy concentration is expected to decrease with annealing in vacuum, this data suggests a new model is necessary. Preliminary hard and conventional x-ray photoemission, and Rutherford backscattering results indicate that high vacuum annealing decreases the concentration of gallium interstitials, which may be the origin of the conductivity phenomenon in this material.

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