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Correlation between native defects, conductivity and green luminescence in ZnO single crystals NARESH ADHIKARI, PETR STEPANOV, POONEH SAADATKIA, MICAH HASEMAN, JACK T. WARFIELD, Bowling Green State Univ, GERALD E. JELLISON, LYNN A. BOATNER, Oak Ridge National Laboratory, FARIDA SELIM, Bowling Green State Univ, SELIM LAB, BOWLING GREEN STATE UNIVERSITY TEAM, CENTER FOR RADIATION DETECTION MATERIALS AND SYSTEMS, OAK RIDGE NATIONAL LABORATORY TEAM — Zinc oxide (ZnO) attracts great attention in the optoelectronic field due to its direct wide band gap and high exciton binding energy. Native point defects play a significant role on the electrical and optical properties of ZnO and should be well investigated to control the electronic properties of ZnO. In this work, bulk ZnO single crystals grown by different methods were studied using a wide range of characterization techniques including Hall Effect, Thermo-luminescence (TL) spectroscopy, Photoluminescence spectroscopy (PL), Positron Annihilation Lifetime Spectroscopy (PALS) and digital coincidence Doppler broadening positron annihilation spectroscopy. It was found that the increase in well-known green luminescence is associated with the decrease in conductivity and charge carrier concentration. Positron lifetime spectroscopy measurements were carried out to reveal the origin of defects responsible for decreasing the conductivity and enhancing the green luminescence. Thermoluminescence measurements reveal that the presence of hydrogen donors in the conductive samples. Lastly, it was interesting to observe the decrease in the ratio between green luminescence to near band emission with increasing laser power.

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