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Characterization of High-purity Germanium Crystals for Rare Event Physics Program MIRANDA SMITH, University of South Dakota, CENTER FOR ULTRA-LOW BACKGROUND EXPERIMENTS IN THE DAKOTAS COLLABORATION — Germanium detectors are made with high-purity crystals grown in a hydrogen atmosphere at the University of South Dakota. Before these crystals can be effectively utilized, they need to be characterized for their purity, dislocation density and carrier mobility. These measurements will provide feedback to improve the crystal growth process. X-ray diffraction is used to determine the orientation of grown crystals and quality of crystalline structure. Dislocations occur when the crystal lattice structure of the germanium does not stay uniform throughout the layers. Dislocation density should be within a range of 100-10,000/cm^3 in order to avoid hydrogen-bonding issues. Our group has achieved acceptable dislocation densities of 3294/cm^2 and 7361/cm^2. The crystals have reached purity levels of 99.99999999999%, but remaining unintentional impurities need to be identified to verify their nature and source. We used Photothermal Ionization Spectroscopy to determine shallow level impurities. These results are incorporated with the Van Der Pauw Hall Effect measurement, which is used to determine whether the crystal is n-type or p-type, as well as the carrier concentration and mobility. The dominant impurities are Al, B, and P. We show an entire calibration program in our research group.

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