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Purification of Germanium Crystals by Zone Refining[1] KYLER KOOI, GANG YANG, DONGMING MEI, Department of Physics, University of South Dakota — Germanium zone refining is one of the most important techniques used to produce high purity germanium (HPGe) single crystals for the fabrication of nuclear radiation detectors. During zone refining the impurities are isolated to different parts of the ingot. In practice, the effective isolation of an impurity is dependent on many parameters, including molten zone travel speed, the ratio of ingot length to molten zone width, and number of passes. By studying the theory of these influential factors, perfecting our cleaning and preparation procedures, and analyzing the origin and distribution of our impurities (aluminum, boron, gallium, and phosphorous) identified using photothermal ionization spectroscopy (PTIS), we have optimized these parameters to produce HPGe. We have achieved a net impurity level of $\sim 10^{10}/\text{cm}^3$ for our zone-refined ingots, measured with van der Pauw and Hall-effect methods. Zone-refined ingots of this purity can be processed into a detector grade HPGe single crystal, which can be used to fabricate detectors for dark matter and neutrinoless double beta decay detection.

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