Bridgman growth of high-purity crystals for rare events physics

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The experiments for rare events physics need ultra-high sensitivity detectors and make use of high-purity materials, especially from radio-purity point of view with extremely low concentration of U, Th and K. The preparation of crystals used in this field is particularly challenging because it implies dedicated methods for the entire production process from synthesis of raw materials to the final mechanical processing, further handling and installation in the experimental setup. The growth of such crystals is the key point and the most challenging job. Bridgman method with sealed platinum crucible can preserve the purity of raw material and even present purifying effect during crystal growth.

The current work will make a review of our experience on modified Bridgman growth of TeO_2 crystals and NaI crystals for neutrinoless double beta decay (0νDBD) and dark matter experiments, respectively. Double growth technique was introduced for the production of high-purity of TeO_2 crystals, both in natural and enriched crystals. Double-walled platinum crucibles were used for the growth of NaI(Tl) crystals of up to 8 kg in weight for dark matter experiments performed at room-temperature. Ultrapure NaI crystals with hexagonal shape were produced for the use at cryogenic temperatures in the COSINUS experiment and ultra-thin wall alumina cases were introduced for the encapsulation of cylindrical NaI(Tl) samples used for room-temperature tests needed for the same experiment.

References

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