Growth of $Li_2{}^{100}MoO_4$ scintillating crystals by LTG Czochralski technique for neutrinoless double beta-decay search

Grigorieva V.D.*, Shlegel V.N.
*grigoryeva@niic.nsc.ru
Nikolaev institute of inorganic chemistry SB RAS, Russia

Neutrinoless double beta decay search is one of the most significant tasks in elementary particle physics. The detection of this process will provide information on such fundamental issues as the absolute neutrino mass scale, the type of neutrino hierarchy (normal or inverse),. Discovery of this process will immediately prove Majorana nature of the neutrino and lead to the discovery of a new elementary particle – the majoron. The sensitivity of modern experiments to the half-life of nuclei has been brought to ~ 10^{25}–10^{26} years [1].

The low-thermal-gradient Czochralski technique (LTG Cz) developed at NIIC SB RAS is a unique technology for growing large crystals crystals of high optical quality. It is significantly important for scintillating and bolometer crystal growth with working element size starting at 40*40 mm^3. Constructional differences from the conventional Czochralski technique reduce axial and radial temperature gradients in growth zone by two orders of magnitude, to values less than 1 deg/cm. In LTG Cz the amount of thermoelastic stresses and defects in the growing crystal is reduced, the processes of melt components volatilization are suppressed, thus, the loss of initial compounds is prevented, which is extremely important when working with expensive isotopically enriched materials.

In presented work prediction method of optimal growth parameters for new compounds based on Jackson criterion of the material is proposed. Method consistency was proved by BGO, Li_2MoO_4, $Na_2Mo_2O_7$, Li_2WO_4 crystal growth [2].

Fig. 1. $Li_2{}^{100}MoO_4$ Mo-100 enriched monocrystals grown by LTG Cz [3].

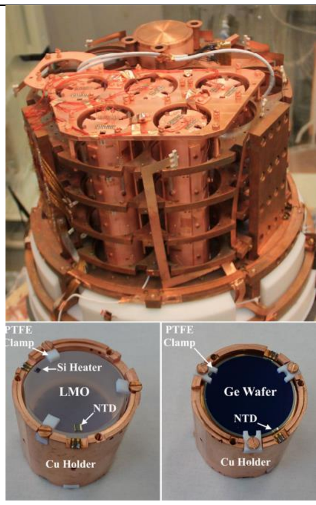

Fig. 1. CUPID-Mo detector array mounted in the EDELWEISS cryostat (top) and a single module assembled in the Cu holder (bottom) [4].

References

[1] A.S. Barabash. Main features of detectors and isotopes to investigate double beta decay with increased sensitivity. Int. J. Mod. Phys. A.2018;33:1843001.
[2] Grigorieva V.D. et al. Bolometric molybdate crystals grown by low-thermal-gradient Czochralski. J. of Crystal Growth.2019;523:125144.
[3] Grigorieva V.D. et al. $Li_2{}^{100depl}MoO_4$ crystals grown by low-thermal-gradient Czochralski technique. J. of Crystal Growth.2020;552:125913.
[4] Augier C. et al. Final results on the 0νββ decay half-life limit of 100Mo from the CUPID-Mo experiment. Eur. Phys. J. C.2022;82:1033.