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DEVELOPMENT OF CRYOGENIC LOW BACKGROUND DETECTOR BASED ON ENRICHED ZINC MOLYBDATE CRYSTAL SCINTILLATORS TO SEARCH FOR NEUTRINOLESS DOUBLE BETA DECAY OF ^{100}Mo

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Neutrinoless double beta (0ν2β) decay is an extremely rare process sensitive to the absolute neutrino mass and the neutrino-mass hierarchy, able to establish the nature of neutrino (Majorana or Dirac particle), check the lepton number conservation, contribution of right-handed admixture to weak interaction, existence of Nambu-Goldstone bosons (majorons). Cryogenic scintillating bolometers are promising detectors to search for 0ν2β decay thanks to their high energy resolution, high detection efficiency and excellent α/β discrimination. High quality ZnMoO4 scintillators with mass of ~ 0.3 kg were produced by using the low-thermal-gradient Czochralski technique in the framework of the LUMINEU project. $Zn^{100}MoO4$ crystal enriched in the isotope 100Mo was grown for the first time. The optical and luminescent properties of the produced crystals were studied to estimate the progress in crystal growth quality. The low-temperature tests with a 313 g ZnMoO4 scintillator and two enriched Zn100MoO4 detectors with mass ~ 60 g were performed aboveground in the Centre de Sciences Nucléaires et de Sciences de la Matière (CSNSM, Orsay, France). The low background measurements of two ~ 0.3 kg of mass ZnMoO4 crystal scintillators are in progress in the EDELWEISS set-up at the Laboratoire Souterrain de Modane to estimate radiopurity level of the detectors. We have simulated 48 $Zn^{100}MoO4$ crystals Ø60 × 40 mm installed in the EDELWEISS cryostat. The contribution to background from the internal radioactive contamination of the crystals, cosmogenic activation and radioactive contamination of the set-up were estimated. Random coincidence of events (particularly from two neutrino double beta decay) could be one of the main sources of background in the search for neutrinoless double beta decay with $Zn^{100}MoO4$ cryogenic bolometers due to their poor time resolution. We have developed pulse-shape discrimination technique to reject the background substantially.

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