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Production of low radioactive samples for low background experiments

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Laboratories created for low-background measurements intensively carried out fundamental physics research, studying neutrinoless double beta decay, neutrino detection, etc. The level of radioactive background is the main indicator for experiments studying rare natural phenomena. One of the most important components of successful research in this field is the acquisition of materials purified from possible radioactive impurities. Fluxes are often used in low-background experiments in the manufacture of electronic devices. Literature data indicates radioactive isotopes of the elements U, Th, and K, which pose problems for low-background studies, have been found in commercially available solders.1 Therefore, it is an actual issue to develop a methodology for purchasing fluxes in accordance with the requirements for conducting low-background experiments.
In this work, we report the production process of a low-radioactive ammonium salt flux. The initial components (HCl and NH4OH) were purified from radioactive elements by sub-distillation method. It was determined that the concentration of U, Th elements in hydrochloric acid was reduced by 20-25 times by evaporating with the method of sub-distillation carried out in three stages. The syntheses of the salt was carried out in gas-liquid phases. To achieve high purity of the final product all the processes were performed in a clean room (JINR, Dubna) An instrumental neutron activation analysis, atomic emission and mass spectrometric methods have been performed to estimate the radioactivity level of the product.
Synthesized salts that meet modern requirements in terms of purity were purer than their commercial analogues and recommended for use in several of low background experiment projects by the Joint Institute for Nuclear Research.2,3
[1] D.S.Akerib et al.// NIM A. 1997. V.400. P.181.
[2] Q. Arnaud et al., Optimizing EDELWEISS detectors for low-mass WIMP searches, Physical Review D 97 (2) (2018) 022003
[3] E. Armengaud et al., The CUPID-Mo experiment for neutrinoless double-beta decay: performance and prospects (2019) [https://arxiv.org/abs/1909.02994]

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