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Perspectives of the ultra-pure titanium as construction material for future low background experiments

The constant increase in mass of the cryostat, containment tanks, passive shielding and other mechanical elements of the modern low background detectors put more stringent requirements on their radio-purity levels. In general they have to be below 1 mBq/kg of 238U / 232Th or lower, which means that mass concentration should be less 0.1 ppb for 238U and less 0.25 ppb for 232Th. Traditionally, the field relies on specially selected low background stainless steel, electrochemical oxygen-free copper, or a combination of the two. However, the most promising material in terms of physical and mechanical properties is Titanium. Our study of various Ti samples show that the levels of contaminations of commercially available industrial titanium can varies from 0.2 to 100 mBq/kg for U/Th. Therefore, the only possible way to obtain the material with a low and controlled level of contamination is to develop (or improve the existing) the production technology and to build the dedicated manufacture line. Our study of the titanium sponge production process (Kroll-process) aims at finding sources of U and Th contaminations and their migration during multistage process. To understand U and Th migration during the Kroll process, we have studied a distribution of other impurities by means of precise ICP-MS analysis. Preliminary results have confirmed that the Kroll process could be used for ultra pure titanium sponge production. The further production stages of metal titanium parts with necessary mechanical properties from titanium sponge need to be additionally studied.

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