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Ultra-low Background Flexible Cables

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Readout cables for signal sensors are a necessary component of rare event searches for neutrinoless double beta decay and particle-like dark matter. While possessing unique mechanical and electrical properties, polyimide-based flexible cables can be a significant contributor to the total detector background, due to their relatively high content of natural radionuclides. Contaminations of U-238 and Th-232 in commercially available flexible cables have been measured in the milliBq/kg range, making them incompatible with the stringent radiopurity levels required for next-generation rare event detectors.

In previous work, we have demonstrated the possibility of obtaining low-background (microBq/kg) copper-polyimide laminates which serve as the starting material for flexible cable manufacturing. However, we have found that even when starting with low-background laminates, the cable manufacturing process results in finished flexible cables with high (milliBq/kg) levels of radioactivity.

In this work, each step of the flexible cable manufacturing process was systematically investigated as a potential vector of radioactive impurities using inductively coupled plasma mass spectrometry. Through the investigation of process modifications, the development of cleaning procedures, and surveys of alternative materials, we have demonstrated that the radioactivity content from U-238 and Th-232 can be reduced to microBq/kg levels, roughly $250\times$ lower than previously achievable. We will discuss our key findings, report the current best levels of radiopurity achieved, and discuss plans for making ultra-low background flexible cables commercially available.

Early Career

Yes

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