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Ultra-pure Copper Electroplating and Electroforming for Rare Event Detection Experiments

Rare event detection experiments, such as direct dark matter and neutrino-less double beta decay searches, pose stringent limits on the experimental backgrounds in order to achieve the required sensitivities to discover new physics. The backgrounds introduced by radioisotopes in the detector construction materials must be carefully considered. Thanks to having no long-lived radioisotopes and being easily electrochemically purified, copper is a popular choice. As a result, the development of electroforming or electrodepositing ultra-pure copper has been an area of intense research and development for future generations of rare-event experiments. An overview of the electroforming process will be given along with the achieved radiopurity, such as the ultra-pure copper produced and measured by the Pacific Northwest National Laboratory, compared to commercially available copper. The current use of electroformed copper by various experiments will also be presented, including the recent cladding type electroplating performed by the NEWS-G direct dark mater search experiment, and its predicted impact on the sensitivity. The cladding is a thin layer of electroplated copper over the commercial copper substrate. It's purpose is to reduce the impact of lead-210 that was found to be at levels higher than expected in the commercial copper. Proposed future applications of electroforming in rare-event searches will also be discussed.

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