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Laser Ablation Mass Spectroscopy of Polyethylene for U

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Content

Large amounts of polyethylene (PE) are used as neutron shielding in low background radiation detectors. PE is a commodity material with many fabricators. Careful analysis of one lot or sample does not assure all the material needed will have adequately low U and Th levels. Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) is the most widely applied trace chemical assay technique, but it requires clean room support and extensive sample preparation. Laser Ablation Mass Spectroscopy (LA-MS) only requires a clean flat surface for analysis. However, experimental variables related to the equipment and samples make quantification difficult. This study compares conventional sample dissolution followed by ICP-MS of a heavy metal polyethylene (PE), ultra-high molecular weight polyethylene (UHMW) and high-density polyethylene (HD) to LA-MS. The Certified Reference Material (CRM) is for cadmium, strontium, and lead. the material mass ablated in a laser raster area is used to quantitate the LA-MS signal. In addition, the LA-MS behavior of lead (Pb) in the PE standard appears to be similar enough tot he behavior of uranium (U) in the standard that the LA efficiency of lead can be used to estimate the LA efficiency of the uranium. Results indicate that LA-MS compares well to dissolution followed by ICP-MS when the mass ablated and ion efficiency are determined for the specific ablation set up (laser type, power, frequency, focus, raster speed, etc.). LA-MS gave U concentrations within a factor of 2-3 of the more rigorous acid digestion followed by ICP-MS. U levels in the 10s to 100s of pg/g are reproducibly measured in the commercial samples. Primary sources of error are consistent placement of the sample after weighing and the small mass ablated i some measurements. The mass ablated quantification is compared to the volume ablated for selected samples.

About the Presenter

Mary Bliss, Ph.D., is a materials scientist who has been working in radiation detection and nuclear sciences since joining PNNL in 1990. She has a bachelor's degree in Ceramic Science from Alfred University, a master's degree in Ceramic Science from the Pennsylvania State University, and a Ph.D. in Solid State Science from the Pennsylvania State University. She worked in the composition control and applied research group at Coning while in college. Her Master's thesis was on the molten salt growth of piezoelectrics for sonar applications and her doctorate research was on the absolute infrared intensities of the silicon to oxygen bond in minerals. She worked briefly at General Electric Neutron Device where she was in a production support group that focused on materials acceptance, production problems, and contamination issues. Dr. Bliss and her team won an R&D 100 award and a Federal Laboratory Consortium Technology Transfer Award in 1999 for developing enriched lithium glass fiber neutron detectors. She is the author of over 60 open literature publications and government reports. She has worked on scintillators, wide bandgap semiconductors and a variety of sensors and materials.

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