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Isotopic Analysis Using Electrochemically Modulated Separations On-Line With Inductively Coupled Plasma Time-Of-Flight Mass Spectrometry

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Initial characterization of electrochemically modulated separations (EMS), performed on-line with an inductively coupled plasma time-of-flight mass spectrometer (ICP-TOF-MS) are presented. EMS is a separation method that has been shown to improve sensitivity of ICP-MS analysis by a factor of one hundred and to vastly reduce bench top chemistry. In prior work, we have demonstrated the separation and on-line preconcentration of uranium and plutonium, as well as other elements, utilizing a quadrupole based ICP-MS.

EMS relies on the ability to change the analyte retention of a surface by changing (i.e., modulating) the voltage applied to an electrode exposed to the sample. The analytes are first accumulated and then rapidly stripped from a working electrode in a flow-by (amperometric) electrochemical cell, thereby providing a transient analyte peak.

Results obtained using orthogonal geometry ICP-TOF-MS to sample the transient EMS signal are presented. The ability to monitor all elements is shown to be beneficial in determining the efficiency and specificity of the EMS technique for all elements simultaneously. Isotope ratio measurement capabilities are presented for the selective accumulation and stripping of uranium, including direct analyses of uranium in seawater.

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