Ion Beam Techniques for Nuclear Waste Management

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In the field of nuclear waste management, the determination of difficult to measure isotopes are important for the isotopic nuclide inventory in disposal material. Accelerator mass spectrometry (AMS) can propose a new precise and reliable way for the quantification of the radioactive material by the means of direct atom counting.
One example is the measurement of ^{14}C, which is normally measured with the liquid scintillation technique (LS). The AMS technique offers a much higher sensitivity which becomes crucial for future German clearance levels of 0.1Bq/g. In addition no pre-treatment of the samples are needed. Especially in the case of reactor concrete originated e.g. from the bio-shield of a nuclear power plant, the sample material can be directly burned in an Elemental Analyzer (EA) and the extracted CO_2 gas can be delivered to the AMS system.
For the radiological characterization of radioactive material, the reference nuclides ^{60}Co or ^{152}Eu are normally used, because they are relatively easy to measure by gamma ray spectroscopy. The disadvantages are the relatively short half-lives and in the case of reactor concrete they are produced at trace elements. Therefore, we investigated the suitability of ^{41}Ca as a reference isotope for reactor concrete. Over one hundred defined neutron irradiated heavy concrete samples, with isotopic ratios in the range of $1.0x10^{-12}$ to $1.0x10^{-9}$, were measured at the Cologne AMS system. The results confirm that AMS is very well suited for decommissioning purposes.
In addition, the technique of Projectile X-ray AMS (PXAMS) offers the opportunity to measure medium mass isotopes like ^{90}Sr, by the measurement of characteristic X-rays. We investigated the X-ray production yields for different target materials in an ion energy range of 0.35 MeV/u to 1.80 MeV/u for the determination of attainable sensitivity.