Some applications of Neutron-Resonance-Capture-Analysis

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Neutron Resonance Capture Analysis (NRCA) has been developed in a joint effort by IRI and IRMM as a new method for analysing the elemental composition of materials and objects. It is based on the occurrence of resonances in neutron capture at energies typical for each element (isotope). Energies of captured neutrons can be determined with the Time-Of-Flight (TOF) method using a pulsed neutron source and detecting the prompt gamma-radiation following neutron capture. Since it is not necessary to determine the energies of the prompt gamma-rays and since most of the capture events are followed by cascades with about 3 to 6 prompt gamma-rays, it is possible to achieve large detection efficiencies using a set of scintillation detectors [1]. It is a fully non-destructive method, that is applicable to many elements, determines the bulk elemental composition, does not require any sample preparation, and results in a negligible residual activity. We have applied NRCA in studies of a series of bronze (pre)-historic artefacts from various sources. We consider exploitation of NRCA for other purposes, notably to detect neutron-absorbing isotopes for nuclear materials in order to quantify impurities in reference materials, to verify the presence of lanthanides in reprocessed fuel and to detect the presence neutron poison in bulk uranium samples. Recently we started the latter application in collaboration with FBFC using pellets of uranium oxide mixed with some gadolinium oxide.

[1] H.Postma et al., J. Radioanalytical and Nuclear Chemistry, 248 (2001) 115

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