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ORAL PRESENTATION - Prompt Gamma Activation Analysis close to Detection Limits

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The ultimate detection limits (DL) of the Prompt Gamma Activation Analysis (PGAA) method depend strongly on the amount and matrix of the measured sample as well as on the background signal contribution to the signal coming from the sample itself.

Recently, we have performed few experiments close to the detection limits for given elements at the high-flux-PGAA facility at FRM II in Garching. One of the most important element which can be determined by the PGAA technique is Hydrogen. Hydrogen impurities in Silicon as well as Hydrogen implantation in Beryllium crystals were measured and analysed. Concerning Silicon, which appears frequently in the nature and so in the PGAA samples, we could determine 3 ppm Hydrogen in the crystals. However, the constrain appeared to be the Hydrogen from the surrounding materials (which cannot be avoided) and we estimate its signal being comparable to a concentration of about 1 ppm.
The Hydrogen implantation to Beryllium crystal was measured by slightly different conditions to lower the Hydrogen contribution from the surroundings of the sample. The analysis is still in progress and exact values will be known soon.

Another experiment testing the limits of the PGAA facility at FRM II was performed in a frame of a Transmutation detectors (TMD) proposal. TMD's are small high-purity metallic foils or single crystal samples, irradiated close to the reactor core at any research or power reactor for a long time (even months). To calculate the neutron flux as well as fluence at the position, not the activity of the detectors after long-term irradiation is analysed, but the concentration of transmuted isotopes with appropriate neutron capture cross-section. The main advantage of this method is the independence of the time parameter: the information is "stamped" to the samples and can be read any time later. The samples irradiated for 21 days at the LWR-15 in Rez, Czech Republic, were pure natural Copper, Aluminum and Gold, the searched isotopes were 59-Ni and 63-Ni in Ni foil, 64-Ni in Cu foil, 198-Hg and 199-Hg in Au foil [ref.1]
In this presentation, the experiments and the results will be discussed and possible ways how to improve the detection limits will be proposed.

[1] L. Viererbl et al., Nucl. Instum. Meth. A 632 (2011) 209.

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