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The Combination of Chemical Analysis and Imaging with Neutrons

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At MLZ, we have three different methods using cold, thermal, and fast neutrons for the determination of the elemental composition in various samples. (1) Cold neutrons are guided to the Prompt Gamma Activation Analysis (PGAA) facility in the Neutron Guide Hall West. The PGAA method is based on the measurement of the prompt gamma radiation released during the de-excitation of the compound nucleus formed in neutron capture. (2) In classic Neutron Activation Analysis (NAA), the delayed gamma radiation is used instead. Taking into account the different half-lives of the activation products, a variation of irradiation, cooling and measurement times enables an optimized detection for each element. (3) The Fast Neutron-induced Gamma Spectrometry (FaNGaS) is a unique instrument built by Jülich Centre for Neutron Science (JCNS). It applies the gamma radiation of the (n,n') reactions induced by reactor neutrons. The FaNGaS instrument shares a beam port with the instruments NECTAR and MEDAPP. Originally, these complementary methods are suitable for bulk analysis. For PGAA, we have already implemented an add-on which provides spatially resolved information of the elemental composition. The results from PGAA sub-volume measurements are combined with the absorption coefficients from Neutron Tomography. This is called Prompt Gamma Neutron Activation Imaging + Neutron Tomography (PGAI/NT). As a next step, we discuss a possible combination of the capabilities of FaNGaS and NECTAR in order to offer spatial resolved measurements also with fast neutrons. Single-event mode will play a key role in this context.

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