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Sensitivity of in-beam neutron activation analysis

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In-beam activation analysis, i.e. the combination of prompt gamma activation analysis (PGAA) using neutron beams from research reactors combined with neutron activation analysis (NAA), can in principle be performed at many neutron centers all over the world. Thanks to its strong beam flux (max. 6E10 cm^-2 s^-1), at Heinz Maier-Leibnitz Zentrum (MLZ), Garching, Germany it has been successfully implemented and used for several years now. The flux value almost compares with those in miniature neutron sources, or Slowpoke reactors, while the sample size can be much larger.
The great advantage of the technique is that in many cases the irradiation can be combined with a PGAA measurement yielding the major and minor components of the sample, in other words the composition of the matrix, thus any neutron self-shielding effects can be determined even for components having no or just weak radioactive daughter products (e.g. B, Li, or even Cd). There are components which can typically be determined using both PGAA and NAA and can be used as internal standards (e.g. Na, or Mn), so the method can be performed in a relative way eliminating several error sources. However, the absolute ways has also been performed successfully. Many short-lived nuclides which are hard to determine from the decay spectra, can be detected in the prompt spectra (like F, Al, V, etc.) with reasonable sensitivities. In-beam activations analysis does not compete with INAA for the detection of trace elements, its detection limits may be 1-2 orders of magnitude worse for the typical NAA elements, however it adds a set of nuclides, which are hard to reach with NAA.
At MLZ, the method has successfully been implemented with broadening the analytical capabilities of PGAA with the determination of many trace elements. Their sensitivities are compared with those of other typical facilities for activation analysis. The facility and a few applications are also presented.

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