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Neutron Depth Profiling with Multipixel Detectors

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Neutron Depth Profiling (NDP) is a specific non-destructive nuclear analytical technique used for determination of depth distributions of some technologically important light elements (e.g., Li and B) in the near surface of solids. The NDP for thick samples (with a thickness > several micrometers) is utilized as a 1D profiling technique that enables to obtain a 1D depth distribution (assuming the uniform lateral distribution). In this case, the measurement is performed with a standard semiconductor detector (or a combination of several detectors arranged in a telescope, etc.) with high energy resolution that, consequently, also allows to obtain high depth resolution (~ 10 nm nominal resolution can be achieved). NDP for thin samples can (advantageously) adapt sophisticated detector systems that enable to detect both reaction products (emitted into opposite directions) simultaneously. Consequently, the sandwich arrangement of the NDP spectrometer (i.e., detector-sample-detector) can dramatically reduce (or even eliminate) the unwanted background and improve the detection sensitivity. Interestingly, as detector systems, placed on both sides of the inspected samples, multipixle detectors (e.g., Timepix, Medipix) can be utilized. Here, the first results of the 3D NDP with multipixle detectors are presented. As samples, thin polymeric foils with B or Li atoms, distributed in the microstructured arrays, were utilized. The obtained data showed that the 3D NDP version proved to be an interesting tool for analysis of the 3D micro-distributions of the NDP-relevant elements in thin samples. This capability might be attractive for electronic industry (where B or Li play an important role) or neutron micro-radiography.

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Primary author: Dr VACÍK, Jiří (Nuclear Physics Institute ASCR)

Co-authors: Dr GRANJA, Carlos (Institute of Experimental and Applied Physics CTU); Dr TOMANDL, Ivo (Nuclear Physics Institute ASCR); Dr KRAUS, Václav (Institute of Experimental and Applied Physics CTU); Mr MORA, Yesid (Institute of Experimental and Applied Physics CTU)

Presenter: Dr VACÍK, Jiří (Nuclear Physics Institute ASCR)

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