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Four Dimensional Isotope Tracking with the N4DP Instrument at MLZ

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Neutron Depth Profiling (NDP) is a non-destructive, element-specific, high-resolution nuclear analytical technique, which is often used to probe concentration profiles of lithium, boron, nitrogen, helium, and several other light elements in different host materials. The N4DP instrument is located at the Prompt Gamma Activation Analysis (PGAA) beamline of Heinz Maier-Leibnitz Zentrum (MLZ), which provides a cold neutron flux up to $5 \times 10^{10}\,\mathrm{s}^{-1}\mathrm{cm}^{-2}$. When a neutron is captured by a specific nuclide, ions with well-defined energies are emitted. The energy loss of the charged particles traveling through the host material is related to the depth of origin at a resolution level up to tens of nanometers.

We developed a detector system based on double-sided silicon strip detectors (DSSSD) with extremely thin and homogeneous entrance windows to provide a new quality of NDP measurements for the N4DP instrument. A highly segmented DSSSD with 32×266 stripes, including integrated, self-triggering electronics, was successfully assessed and tested at the research reactor RID in Delft, in the Netherlands. Using a two-detector camera-obscura geometry set-up, we were able to image and reconstruct Li containing targets with space resolution down to $\sim100\,\mu\mathrm{m}\times200\,\mu\mathrm{m}$ and time resolution down to 10 ms. This project is supported by the BMBF, Contract No. 05K16WO1, 05K19WO8.

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