

Development of Novel Neutron Detectors with Thin Conversion Layers

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Abstract

The Helmholtz-Zentrum Geesthacht (HZG) operates neutron beamlines at the research reactor FRM II in Germany and is engaged in designing new ones at high flux reactors and the forthcoming European spallation source ESS. For those instruments thermal and cold detectors covering a large part of the spatial angle are needed. Due to the shortage of ³He HZG has started a development of neutron detectors with thin boron conversion layers to be used for high and low resolution diffraction, reflectometry and SANS as well as for inelastic instruments.

The new detectors are required to meet or even to surpass the high performance of current ³He-detectors, this includes especially high neutron and low Gamma sensitivity as well as high local and global count rates. A basic design concept of the new detectors is that neutrons hit conversion layers at small angles (inclined geometry). This distinguishes them from other ones, it results in excellent detection probability and high angular as well as high timing resolution. Two different kinds of these novel detectors are designed. Those for elastic diffractometers have high spatial resolution (less or about 1 mm × about 2 mm) and shall allow for covering medium sized areas (up to 1 m²), whereas those for inelastic instruments have low resolution (about 10 mm to 20 mm) are designed to cover large areas (some 10 m²).

The development comprises the production, characterization and optimization of thin layers with high Boron content as well as the design, manufacturing and testing of these layers in test and prototype detectors. The current status of the development of the conversion layers, the detector design and the characterizations is presented. The development is performed as an in-kind contribution to the ESS instrumentation, and is part of the German support to the ESS Pre-Construction Phase and Design Update.