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Boron-10 based Neutron Detectors at ESS

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In Lund, Sweden, the European Spallation Source (ESS) is currently under construction. In order to cope with the expected high neutron fluxes at ESS and reduce the dependence on Helium-3 gas, which future availability is uncertain, alternative neutron detector technologies are being developed. Here we present an overview of a new generation of neutron detectors for neutron scattering based upon boron carbide thin films, presenting a summary of some of the most recent developments from the ESS Detector Group and Collaborators. The focus will be on the Multi-Grid and Multi-Blade detectors, explaining their working principles and presenting the most recent update on the performance of the Multi-Grid detector. The detectors were first conceptualized at ILL. Thereafter the Multi-Grid design was jointly developed by ILL and ESS, and the the Multi-Blade design jointly by ESS, Lund University, Perugia University and Wigner Institute. Both detectors use boron carbide films coated on Aluminum sheets, and the coating technology of the thin films has been a core part of the work. Neutrons are detected using the neutron capture reaction in Boron-10 coupled with a Multi-Wire Proportional Chamber (MWPC). The two detectors are intended for different instruments within ESS, the Multi-Grid for Spectroscopy and the Multi-Blade for Reflectometry. The Multi-Grid has been developed based on the requirements for the upcoming CSPEC (Cold Neutron Spectroscopy) and T-REX (Thermal Neutron Spectroscopy) instruments at ESS. For these, large area detectors are needed, which is one of the main design parameters for the Multi-Grid. Conversely, the Multi-Blade is a small area detector, were the demand instead concerns beyond the state-of-the-art count rate capabilities and position resolution. These demands are based on the requirements for ESTIA and FREIA instruments. It was found that the performance matches or outperforms Helium-3 based detectors. Furthermore, by demonstrating the technology on the current state of the art instrumentation, the scientific performance for the instrument class intended could be evaluated. Using these new technologies, the Helium-3 needs for ESS can be reduced by over 90 %, while at the same time the ESS instruments requirements for detectors can be achieved and the cost of neutrons detectors reduced. Finally, this new development path for neutron detectors enable future performance gains to be anticipated.

Poster back-up

Yes

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