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Towards a 60 x 60 cm2 demonstrator for the NMX instrument at the European Spallation Source ERIC

Thursday 25 May 2017 09:40 (20 minutes)

Neutron detectors based on solid converters in combination with Micro Pattern Gaseous Detectors (MPGDs) are a promising option for neutron scattering instruments at the European Spallation Source ERIC that require excellent spatial resolution combined with time resolution, high-rate capabilities and a good neutron detection efficiency.

The NMX macromolecular diffractometer will consist of three individual Gaseous Electron Multiplier (GEM) detectors mounted on robotic arms to allow positioning of the detectors in an optimal manner. The detectors will have an active area of 60 x 60 cm^2 each, with a gadolinium cathode acting as neutron converter. They are designed to minimize the dead area within the detector volume as well as the space between the individual detectors when placed in close proximity to each other.

Foils of natural gadolinium are currently commercially available with a maximum surface area of about 20 x 10 cm^2. To achieve large-area gadolinium cathodes as required by the NMX instrument, the foils need to be assembled with a number of restrictions: good electrical conductivity, solid mechanical connection to the supporting cathode frame and a minimum of dead area between each foil. The method employed should be fast, easily reproducible and –owed to the high price of gadolinium –allow easy recuperation at a minimum loss of material.

We present ultrasonic welding of gadolinium foils onto aluminium support structures as a method on how to fulfil the aforementioned restrictions. An introduction to the welding technique will be given, as well as an overview of the very first cathodes produced with this method. Measurements with a mixed Americium-241/Beryllium source demonstrate good overall uniformity and a lack of dead are in a 10 x 10 cm^2 demonstrator cathode comprising three individual gadolinium foils of 25 μm thickness.

The talk will be opened with an overview of the NMX detectors and their experimental requirements. Ongoing studies to improve the neutron detection efficiency with isotopically enriched Gd-157 converters, as well as the cost-effective production of Gd-157 ingots and foils are presented. A summary on the technical design and the current status of the full-scale demonstrator concludes the talk.

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