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| BENSC | **EXPERIMENTAL REPORT**<br><br>**Synchrotron tomography study on disc chopper coatings** | Proposal N° **EF**<br>Instrument<br>**Beamline**/BESSY<br>Local Contact<br>A. Haibel |
| Principal Proposer:<br>Experimental Team: | J. Peters, HMI Berlin<br>J. Peters, HMI Berlin<br>A. Haibel, HMI Berlin<br>A. Rack, HMI Berlin | Date(s) of Experiment<br><br>Feb. – Dec. 2004 |

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Disc choppers (see fig. 1) allow for the production of well defined neutron pulses and the application of the time-of-flight technique at a continuous source. To guarantee for the desired cut-out of the neutron pulse by the chopper window, the surface of the disc has to have a neutron absorbing coating, for instance gadolinium or boron $^{10}$B. The carrier substance of modern discs is often composed of CFRP (carbon fibre reinforced plastic) epoxy. The absorption of the coating depends on the material, its thickness and the homogeneity of the coating layer. A typical requirement is an absorption of > 99.99% at wavelengths ≥ 0.7. These values are also expected for the choppers of the instrument EXED at the HMI.

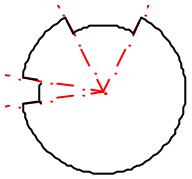

***Fig. 1:*** *Schematical representation of a disc chopper with two windows.*

To check the homogeneity of the coating layer, a tomography study has been carried out at the BAMline at BESSY on three samples with two absorbing coatings, boron and gadolinium. The spatial resolution amounted to 3.6 µm at an incident energy of 15 keV for boron and 30 keV for gadolinium. 900 pictures were taken with an angular increment of 0.2° and a total sample rotation of 180°.

The first measurement (Fig. 2) shows an epoxy support layer (thickness 1.5 mm) coated with $^{10}$B layers with a thickness of 0.3 mm on both sides. On the left hand side a coating with various pores is shown, whereas on the right hand side the very precisely produced layer looks homogeneous.

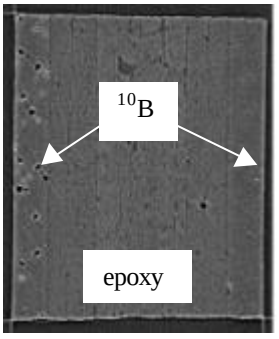


***Fig. 2:*** *Tomographic 2D slice (2x2.5 mm). The homogeneous boron layer can be recognized at the right whereas the left layer shows various pores. Pores with diameters of £ 0.05 mm are admitted by the supplier.*

A second sample, shown in Fig. 3, has an absorbing layer of gadolinium only on one side (thickness 1.064 mm). Various pores are detected, too.

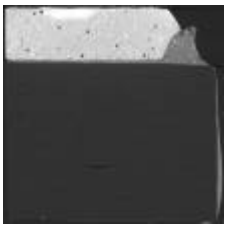

***Fig. 3:*** *Tomographic 2D slice (4x4mm). The gadolinium layer corresponds to the light slice. Various pores in the coating material are detected, too.*

In Fig. 4 a tomographic image of the chopper coating material gadolinium of a real window cut-out is plotted.

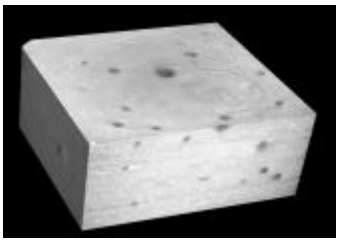

***Fig. 4:*** *Tomographic picture of the chopper coating material gadolinium (1.5x1.5x1mm).*

In all samples pores with a size of 20 to 120 µm were found (see Fig. 5). While in the chopper material made of $^{10}$B (red) more small pores and a small pore size distribution occur, the gadolinium chopper material (green) shows a broad pore size distribution and larger pores. For the third chopper material (blue), the lowest porosity was found.

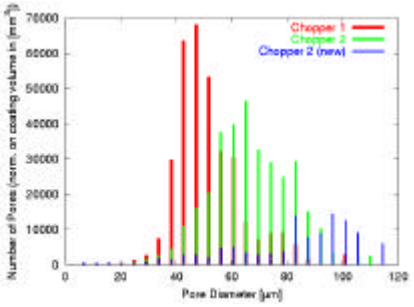


***Fig. 5:*** *Pore size distribution of the three investigated coatings.*

Furthermore in this latter material the pore size distribution is homogeneous enough to guarantee for sufficient absorption .

Theoretically, gadolinium is the better absorber for higher wavelengths (> 0.85 Å), however at these wavelengths the absorption is already that high that all in all boron works more effectively.