Forschungszentrum Dresden Rossendorf

Experiment Report Form

The double page inside this form is to be filled in for each experiment at the Rossendorf Beamline (ROBL). This double-page report will be reduced to a one page, A4 format, to be published in the Bi-Annual Report of the beamline. The report may also be published on the Web-pages of the FZD. If necessary, you may ask for an appropriate delay between report submission and publication.

Should you wish to make more general comments on the experiment, enclose these on a separate sheet, and send both the Report and comments to the ROBL team.

Published papers

All users must give proper credit to ROBL staff members and the ESRF facilities used for achieving the results being published. Further, users are obliged to send to ROBL the complete reference and abstract of papers published in peer-reviewed media.

Deadlines for submission of Experimental Report

Reports shall be submitted not later than 6 month after the experiment.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report in English.
- include the reference number of the proposal / experiment to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.
- bear in mind that the double-page report will be reduced to 71% of its original size, A4 format. A type-face such as ”Times” or ”Arial” , 14 points, with a 1.5 line spacing between lines for the text produces a report which can be read easily.

Note that requests for further beam time must always be accompanied by a report on previous measurements.

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ROBL-CRG	**Experiment title:** Continuation proposal of 2002647	**Experiment number**: 2002664
Beamline: BM 20	**Date of experiment**: from: 26.04.2008 to: 29.04.2008	**Date of report**:
Shifts: 9	**Local contact(s)**: Carsten Bähtz	*Received at ROBL:*

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Report:

We characterized novel high transmission planar waveguides making use of the third generation synchrotron radiation. The bending magnet BM20 beamline offers high flexebility by the wide and easily accessible energy range on the one hand, giving us the opportunity of testing waveguide samples of different lengths at two characteristic energies. On the other hand, the high precision six-circle goniometer with large sample holder enables accurate sample positioning for exact waveguide characterisation without the need of rearrangement of the different waveguides measured. We used a low noise scintillation detector mounted on the diffractometer arm (712.5mm distance waveguide-detector, 0.52mm slit) for high angular resolution θ-2θ scans of the farfield pattern and the farfield tails.
We have shown the advantages of using an optimized multilayer waveguide design with a *C* guiding layer and a *Mo* interlayer embedded in *Ge* at a hard x-ray energie of 19.5keV in a previous ROBL beamtime (*T.Salditt et al.*, PRL **100**, 184801 (2008)). In this beamtime we have studied the efficiency of the waveguide on a wide energy range by reducing the waveguide length. Prior limitations of the two-component waveguides resulted from the need of efficient blocking of the over-exposed beams. The beam directley above the multilayer optic must be absorbed to isolate only the waveguide

beam. *Ge* and *Mo* enable sufficient blocking of the multi-keV beam at waveguide length down to *l* = 200µm. To place an appropriate material above the 1µm thick *Ge* cladding on the top of the waveguide, two designs were ellaborated and tested at the ROBL beamline. First, making use of the electroless Nickel Plating technique on a thin *Ni* layer deposited by e-beam evaporation where strainless layer thicknesses *d* of up-300µm are realized. Secondly, a *In*52*Sn*48-alloy offers excellent wetting properties on thin *Ni* layers which was exploited to realize a waveguide/alloy/*Ge*-Wafer 'sandwich'.

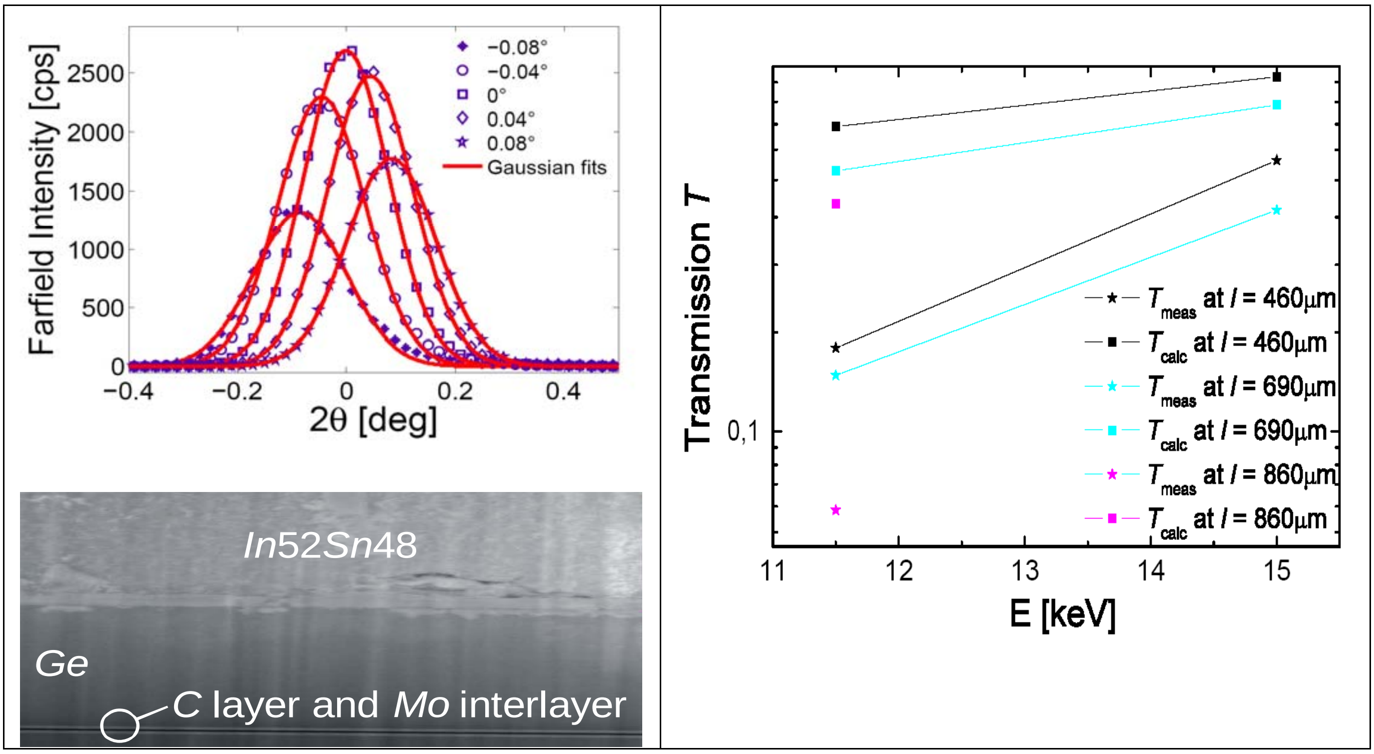

Fig 1: On the left, top: Farfield Intensity for different angles of incidence α_i , along with Gaussian fits. The maximum positions are found to be at α_f = 0°. On the left, bottom: Electron microscopy image of the InSn alloy along with the waveguide multilayer. On the right: measured and calculated values of the transmission T at different energies and waveguide lengths.

We succesfully measured a series of Ge/Mo[d_i = 30nm]/C[d = 35nm]/Mo[d_i = 30nm] waveguides of different length *l* = 460µm/690µm/860µm at two different energies 11.5keV and 15keV with the *In*52*Sn*48-alloy as blocking material. The farfield pattern shown exemplarily on Fig.1 clearily identifies the expected waveguide properties. No artefacts of overexposed beams are measured. This observation is in agrement with the fact that the electron microscopy image shows wetting on the nanometer scale at the interface waveguide/*InSn* alloy. We obtained a maximum transmission *T* = 0.512 for the shortest waveguide at 15keV. The transmission of an ideal waveguide without real structure effects such as interface roughness was determined to be *T* = 0.846 by FD simulations . The measured and calculated values of the transmission for the considered sample series show the strong dependency on the energy and the waveguide length.