ROBL-CRG	**Experiment title:** ***Characterization of waveguide-structures with single- / multimode-guiding-layers***	**Experiment number**: 20_02_021
Beamline: BM 20	**Date of experiment**: from: 17.05.1999 to: 18.05.1998	**Date of report**: 02.09.99
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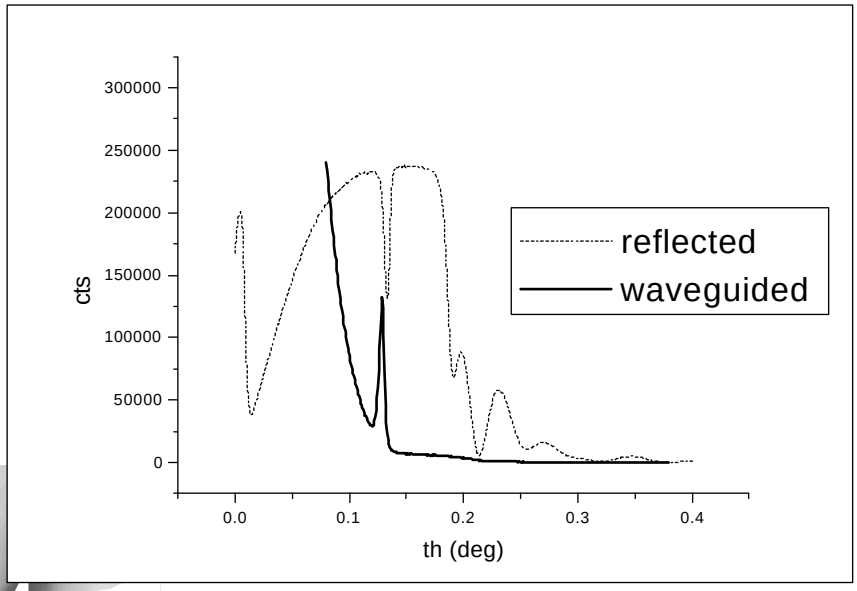
Report:

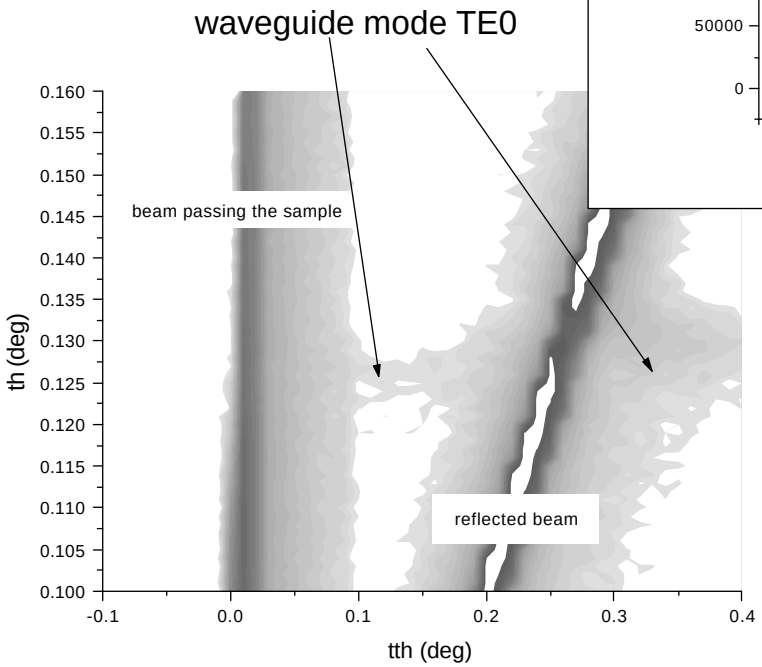
We have fabricated x-ray waveguides [1, 2] by different thin film deposition techniques, and characterized their x-ray optical properties by experiments using a 20 keV synchrotron beam at ROBL (BM20) [3]. A theory to describe the observed effects has been developed and compared to the experimental results. The good agreement confirmed our model and enabled us to design waveguides with several new features by simulating their guiding characteristics, and calculating the efficiencies.

A nearly perfect control of the automated sputter deposition process allowed us to design and study a series of sputtered Ni/C-waveguides varying different structural parameters, ranging from very thick (~ 1500 Å) to ultrathin guiding layers of 100 Å. Only a single mode can propagate in the ultrathin guiding layers, which has never before been observed. At the exit of the waveguide structure, a correspondingly small ”nanobeam” is produced, to our knowledge the smallest beam ever reported.

The farfield patterns of many different wavguide devices have been characterized by two-dimensional mappings, which proved very usefull to identify the resonances and to compare the results to multidimensional field simulations, see below. Furthermore, we have designed and characterized a new class of multiple guiding layer devices, with potential applications in interferometry.

reflectivity and farfield pattern
single-mode waveguide
Ni[70A]/C[100A]/Ni[200A]/Si

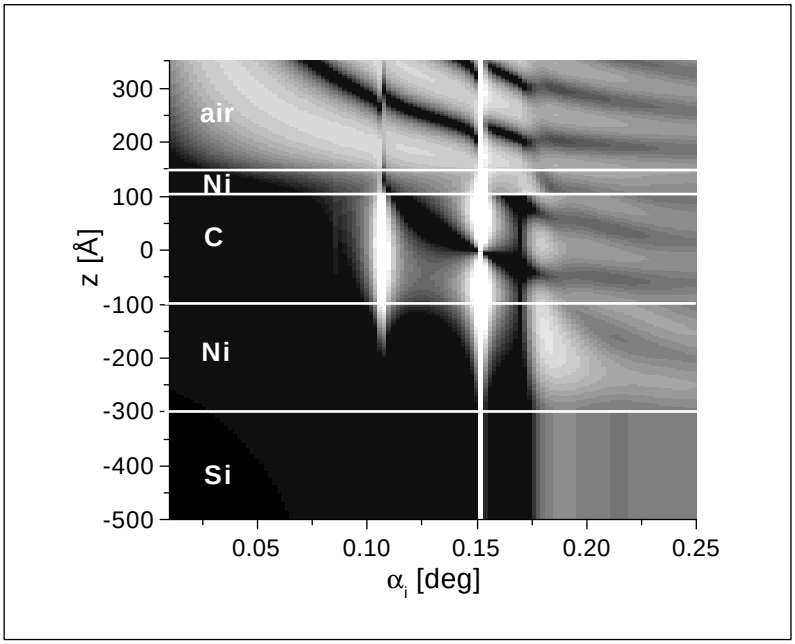




ROBL beamline 08.03.1999
α_i / α_f - mapping, reflectivity and 1:1-scans
20 keV (4 GeV-Mode)

F. Pfeiffer, P. Hoghoj, T. Salditt,
N. Schell (ROBL)

A simulation of the field intensity distribution in a double mode waveguide structure as a function of the incidence angle. A resonant field enhancement of about two orders of magnitude is found in some structures and can be indirectly confirmed from a measurement of the farfield intensity of the exiting beam.



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Y.P. Feng, S.K. Sinha, E.E. Fullerton, et al., Appl.Phys.Lett. **67,** 3657 (1995).
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S. Lagomarsino, A. Cedola, P. Cloetens, et al., Appl.Phys.Lett. **71**, 2557 (1997).
[3] F. Pfeiffer, P.H Høghøj, I. Anderson, T. Salditt, N. Schell, to be published.