Journal of large-scale research facilities

Journal of large-scale research facilities, 3, A114 (2017) http://dx.doi.org/jlsrf-3-154

Published: 24.05.2017

V6: The Reflectometer at BER II

Helmholtz-Zentrum Berlin für Materialien und Energie *

Instrument Scientists:
- Dr. Marcus Trapp, Helmholtz-Zentrum Berlin für Materialien und Energie
  phone: +49 30 8062-43020, email: marcus.trapp@helmholtz-berlin.de

Abstract: V6 is a fixed wavelength reflectometer dedicated to the investigation of thin films and surface structures at solid-air, solid-liquid and free liquid surfaces. The instrument is equipped with polarization analysis for studies of magnetic thin films, also in external magnetic fields and at low temperature.

1 Introduction

The reflectometer V6 allows measuring the neutron optical reflectivities on flat surfaces at grazing angles. The reflectivity is related to the variation of the refractive index within a depth of about 200 nm, thus structural depth profiles can be studied at solid-air, solid-liquid and free liquid surfaces. Using polarized neutrons magnetic properties and magnetic depth profiles can be reconstructed in a unique way. For solid samples the angle of incidence is varied by a precise tilting of the sample surface relative to the (fixed) collimated neutron beam. Liquid samples can also be measured. In this mode the sample surface is kept horizontal and the angle of incidence is varied by precise and synchronized movement of the monochromator tilt angle, the slit system and the sample stage.

The sample-detector distance is variable between 1 m and 3 m.

*Cite article as: Helmholtz-Zentrum Berlin für Materialien und Energie. (2017). V6: The Reflectometer at BER II. *Journal of large-scale research facilities, 3*, A114. http://dx.doi.org/jlsrf-3-154

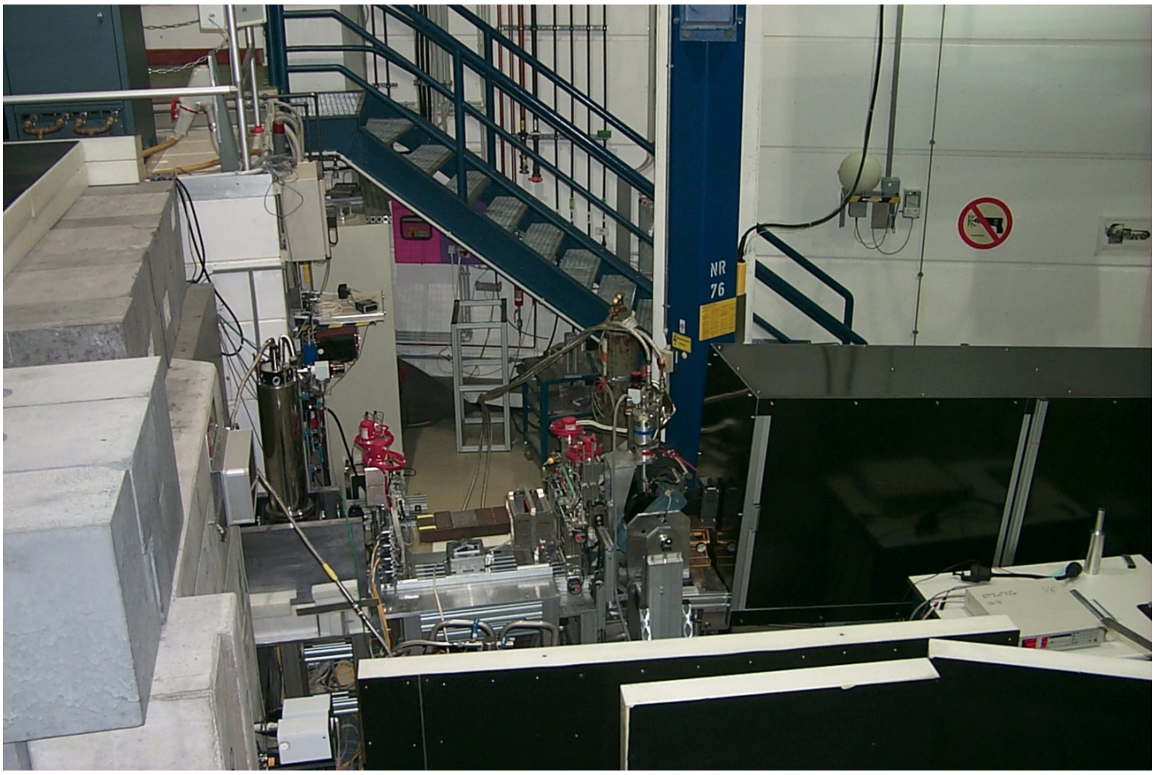

Figure 1: View of V6.

2 Instrument application

Typical applications are:

- Multilayers (inorganic or organic materials)
- Liquid and solid surfaces, solid-liquid interfaces
- Properties of in-plane structured layers

3 Instrument layout

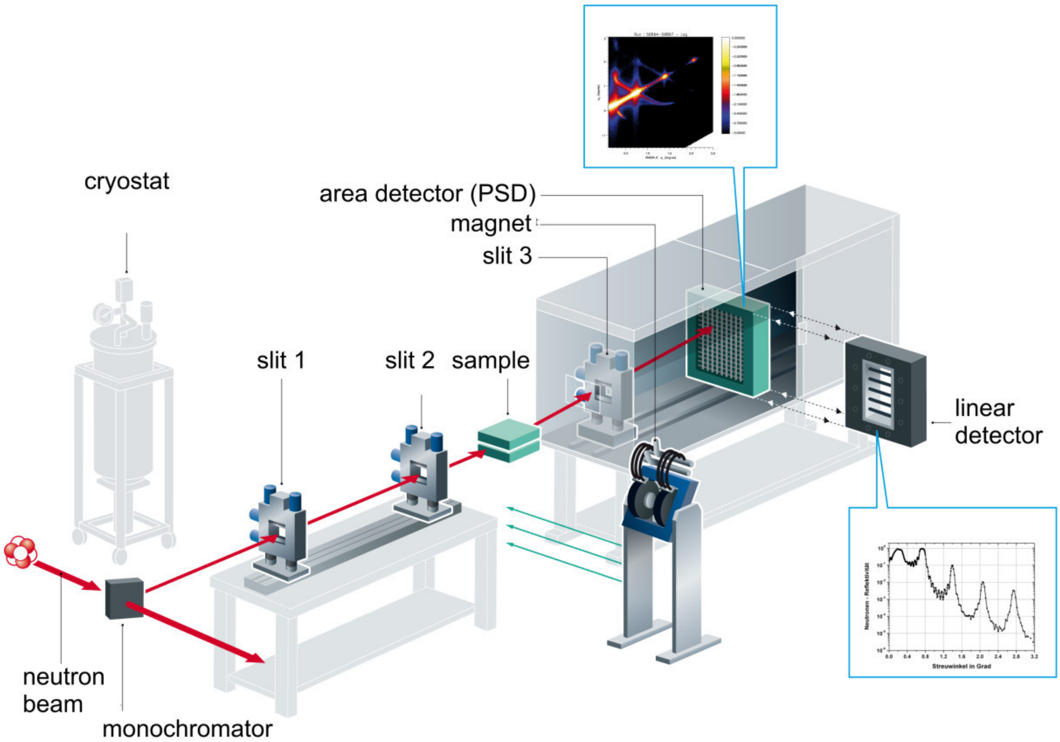

Figure 2: Schematic view of V6

4 Technical Data

Neutron guide	NL 4
Collimation	2 Cd slits (computer controlled)
Monochromator	PG (002) mosaicity: $\delta \lambda/\lambda$ = 2%
Wave length	λ = 0.466 nm
Scattering plane	Vertical
Flux	$3 \cdot 10^4$ n/cm^{2}s
Range of reflectivities	$2 \cdot 10^5$ (with sample site 10x40 mm)
q resolution	$2 \cdot 10^{-2}$ nm^{-1} (depending on collimation)
Detector	48 ^{3}He-detector tubes Optionally multiwire PSD (180 x 180 mm, resolution 1.5 mm) Angular range: 10°(for liquids: 0°- 2.7°) Vertical collimation: 0.01°- 0.05° Angular precision: 0.001°
Polarized neutrons	No
Instrument options	• Solid sample mode • Liquid sample mode
Sample environment	• Sample rotation table (360°) • Heatable sample cells for air-liquid and solid-liquid interfaces • High pressure cell (100MPa) for solid-liquid interfaces • Vacuum and gas loading cells • Langmuir film balance

Table 1: Technical parameters of V6.

References

Früh, J., Rühm, A., Möhwald, H., Krastev, R., & Köhler, R. (2015). Reflectometry on curved interfaces. *Physica B: Condensed Matter*, *457*, 202 - 211. http://dx.doi.org/10.1016/j.physb.2014.08.030

Jerliu, B., Dörrer, L., Huger, E., Borchardt, G., Steitz, R., Geckle, U., … Schmidt, H. (2013). Neutron reflectometry studies on the lithiation of amorphous silicon electrodes in lithium-ion batteries. *Phys. Chem. Chem. Phys.*, *15*, 7777-7784. http://dx.doi.org/10.1039/C3CP44438D

Jerliu, B., Hüger, E., Dörrer, L., Seidlhofer, B.-K., Steitz, R., Oberst, V., … Schmidt, H. (2014). Volume Expansion during Lithiation of Amorphous Silicon Thin Film Electrodes Studied by In-Operando Neutron Reflectometry. *The Journal of Physical Chemistry C*, *118*(18), 9395-9399. http://dx.doi.org/10.1021/jp502261t

Köhler, R., Steitz, R., & von Klitzing, R. (2014). About different types of water in swollen polyelectrolyte multilayers. *Advances in Colloid and Interface Science*, *207*, 325 - 331. http://dx.doi.org/10.1016/j.cis.2013.12.015

Koo, J., Erlkamp, M., Grobelny, S., Steitz, R., & Czeslik, C. (2013). Pressure-Induced Protein Adsorption at Aqueous-Solid Interfaces. *Langmuir*, *29*(25), 8025-8030. http://dx.doi.org/10.1021/la401296f

Menéndez, E., Dias, T., Geshev, J., Lopez-Barbera, J. F., Nogués, J., Steitz, R., … Temst, K. (2014). Interdependence between training and magnetization reversal in granular Co-CoO exchange bias systems. *Phys. Rev. B*, *89*, 144407. http://dx.doi.org/10.1103/PhysRevB.89.144407

Paul, A., Teichert, A., Krist, T., & Steitz, R. (2015). Substrate-stress-induced magnetic and nonmagnetic structural correlations in Fe/Si multilayers. *Journal of Applied Crystallography*, *48*(4), 1023–1033. http://dx.doi.org/10.1107/S1600576715009942

Reinhardt, M., Dzubiella, J., Trapp, M., Gutfreund, P., Kreuzer, M., Gröschel, A. H., … Steitz, R. (2013). Fine-Tuning the Structure of Stimuli-Responsive Polymer Films by Hydrostatic Pressure and Temperature. *Macromolecules*, *46*(16), 6541-6547. http://dx.doi.org/10.1021/ma400962p