Journal of large-scale research facilities

Journal of large-scale research facilities, 2, A99 (2016) http://dx.doi.org/10.17815/jlsrf-2-100

Published: 02.12.2016

BioRef: The Reflectometer for Biological Applications (V18) at BER II

Helmholtz-Zentrum Berlin für Materialien und Energie *

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

Abstract: The time-of-flight neutron reflectometer BioRef is dedicated to the investigation of solid-liquid interfaces, in particular for soft matter applications. The possibility to mount a FTIR-ATR to the sample stage offers the possibility of combined *in-situ* measurements.

1 Introduction

BioRef is a time-of-flight neutron reflectometer with strong focus on soft matter applications, in particular at solid–liquid interfaces in the context of biological model systems under physiological conditions, including non-equilibrium situations. The instrument was built in joint effort of Ruprecht-Karls-Universität Heidelberg (RKU) and HZB within the "BMBF Verbundforschung" funding scheme. Unique features of BioRef are the chopper system, which allows for focusing on a selected Q-range in order to support fast kinetic studies, and the availability of simultaneous *in-situ* infra-red (IR) spectroscopy measurements. The latter complement the structural information provided by neutron reflectivity (NR) with information on the molecules' conformational order.
The add-on IR spectroscopy unit allows for the *in-situ* investigations of Si-supported interfaces in ATR (attenuated total reflection) geometry. A Bruker Vertex 70 infrared spectrometer is installed at the sample position for the very reason. The IR beam enters the Si substrate through the inclined top surface (45°) under 90° incidence, is then totally reflected internally several times at the sample surface (front side) and the backside of the Si-substrate before leaving the substrate through its inclined bottom face and deflected into an external IR-detector. The setup enables combined *in-situ* (kinetic) NR and IR studies with z-resolved depth profiles from about 5 – 420 nm total thickness and conformational information on the embedded molecules acquired at the same time.

* **Cite article as:** Helmholtz-Zentrum Berlin für Materialien und Energie. (2016). BioRef: The Reflectometer for Biological Applications (V18) at BER II. *Journal of large-scale research facilities, 2*, A99. http://dx.doi.org/10.17815/jlsrf-2-100

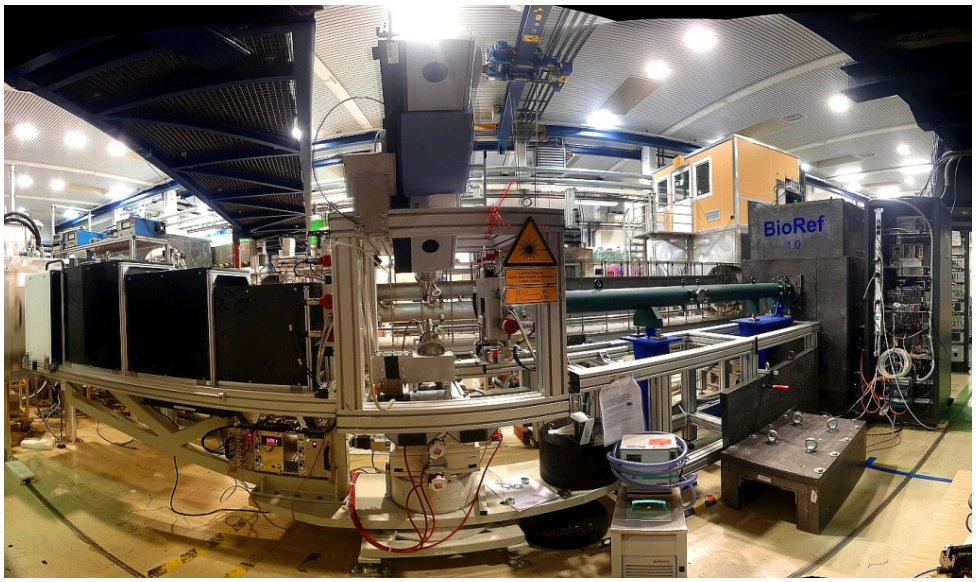

Figure 1: View of V18.

2 Instrument application

Typical applications are:

- Solid-liquid interfaces
- Combined NR and ATR-FTIR measurements
- Time resolved NR

3 Instrument layout

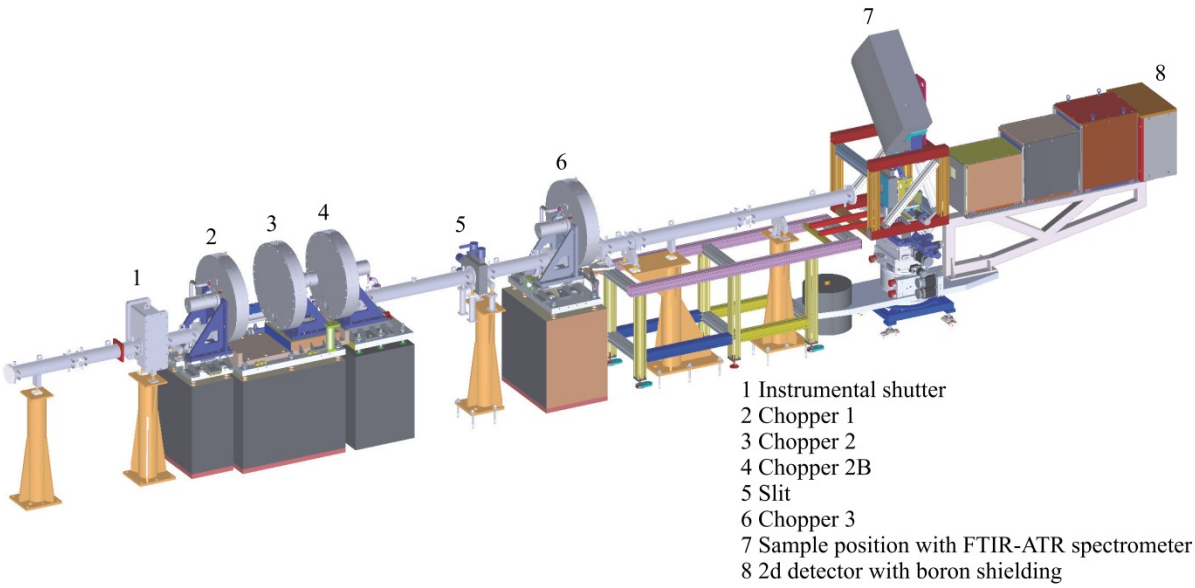

Figure 2: Schematic view of V18.

4 Technical Data

Neutron guide	NL 3b
Wavelength	90 Hz: 2.0 - 6.0 $\AA$ 45 Hz: 2.0 - 10.0 $\AA$ 25 Hz: 2.0 - 16.4 $\AA$
Wave length resolution	Constant $\Delta\lambda/\lambda$ = 1 -5%, 7% - 11%
Scattering plane	Horizontal
Range of reflectivities	1x10^{-7} with a 50x80 mm^2 sample
Q resolution	ΔQ/Q = 1.4 – 7% and 10 – 15%
Detector	300 x 300 mm^2 Multiwire PSD detector
Polarized neutrons	No
Instrument options	Possibility of combined NR and ATR-IR measurements
Sample environment	• Rectangular flow cells (50x80 mm^2) • Round flow cells (∅ 60 mm) • Hydration chamber

Table 1: Technical data of V18.

References

Kreuzer, M., Strobl, M., Reinhardt, M., Hemmer, M., Hauß, T., Dahint, R., & Steitz, R. (2012). Impact of a model synovial fluid on supported lipid membranes. *Biochimica et Biophysica Acta (BBA) - Biomembranes*, *1818*(11), 2648 - 2659. http://dx.doi.org/10.1016/j.bbamem.2012.05.022

Schwörer, F., Trapp, M., Ballauff, M., Dahint, R., & Steitz, R. (2015). Surface-Active Lipid Linings under Shear Load -A Combined in-Situ Neutron Reflectivity and ATR-FTIR Study. *Langmuir*, *31*(42), 11539-11548. http://dx.doi.org/10.1021/acs.langmuir.5b01678

Strobl, M., Steitz, R., Kreuzer, M., Nawara, A., Mezei, F., Rose, M., … Dahint, R. (2010). BioRef – a time-of-flight neutron reflectometer combined with in-situ infrared spectroscopy at the Helmholtz Centre Berlin. *Journal of Physics: Conference Series*, *251*(1), 012059. http://dx.doi.org/10.1088/1742-6596/251/1/012059

Strobl, M., Steitz, R., Kreuzer, M., Rose, M., Herrlich, H., Mezei, F., … Dahint, R. (2011). BioRef: A versatile time-of-flight reflectometer for soft matter applications at Helmholtz–Zentrum Berlin. *Review of Scientific Instruments*, *82*(5), 055101-9. http://dx.doi.org/10.1063/1.3581210

Trapp, M., Steitz, R., Kreuzer, M., Strobl, M., Rose, M., & Dahint, R. (2016). BioRef II—Neutron reflectometry with relaxed resolution for fast, kinetic measurements at HZB. *Review of Scientific Instruments*, *87*(10). http://dx.doi.org/10.1063/1.4964294

Wojciechowski, K., Orczyk, M., Gutberlet, T., Trapp, M., Marcinkowski, K., Kobiela, T., & Geue, T. (2014). Unusual penetration of phospholipid mono- and bilayers by Quillaja bark saponin

biosurfactant. *Biochimica et Biophysica Acta (BBA) - Biomembranes*, *1838*(7), 1931 - 1940. http://dx.doi.org/10.1016/j.bbamem.2014.04.008

Wojciechowski, K., Orczyk, M., Marcinkowski, K., Kobiela, T., Trapp, M., Gutberlet, T., & Geue, T. (2014). Effect of hydration of sugar groups on adsorption of Quillaja bark saponin at air/water and Si/water interfaces. *Colloids and Surfaces B: Biointerfaces*, *117*, 60 - 67. http://dx.doi.org/10.1016/j.colsurfb.2014.02.010