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

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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.

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

<table>
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<tr>
<th>Neutron guide</th>
<th>NL 3b</th>
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| Wavelength    | 90 Hz: 2.0 - 6.0 Å  
               | 45 Hz: 2.0 - 10.0 Å  
               | 25 Hz: 2.0 - 16.4 Å  |
| Wave length resolution | Constant $\Delta \lambda/\lambda = 1 - 5\%$, 7\% - 11\% |
| Scattering plane | Horizontal |
| Range of reflectivities | 1x$10^{-7}$ with a 50x80 mm$^2$ sample |
| Q resolution   | $\Delta Q/Q = 1.4$ - 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 ($\varnothing$ 60 mm)  
                           • Hydration chamber |

Table 1: Technical data of V18.

References


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