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Neutron backscattering for high energy resolution spectroscopy on energy related materials

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Neutron backscattering spectroscopy is an advanced method for studying the microscopic dynamics of materials related to energy and covering many of the topics of this conference. Its strength lies in the possibility to access a wide momentum transfer range up to to high Q with sub-μeV energy resolution. IN16B at ILL with its high flux and signal-to-noise ratio is probably the most advanced spectrometer of this type [1].

A special feature of neutron backscattering at reactors is elastic and inelastic 'fixed window scans'[2] which allow for fast parametric studies with a high monochromatic flux which can be used in a selected narrow energy channel during the full measuring time and can be triggered by or scanned as a function of a sample parameter like temperature, pressure, electric field, light or other stimuli. This allows to detect with high sensitivity the onset of dynamic processes as function of a control parameter, and thus to guide efficient full spectroscopic measurements on BS and TOF instruments. Spectroscopy can then be carried out in a relatively narrow energy range with classical backscattering, in a more extended range in future with BATS [3,4] or if needed to be combined with another TOF spectrometer to complement the energy range.

Recent backscattering experiments on IN16B cover topics like Hydrogen storage, Proton, Sodium, Lithium and Oxygen conduction, ionic liquids, membranes for fuel cells and batteries, materials related to organic and hybrid solar cells and catalysis. The high flux of IN16B has also created new possibilities for in situ or in operando experiments like the first attempt to carry out backscattering spectroscopy on a fuel cell in operation shows.

[1] Frick, B. et al., in preparation; Frick, B. et al. Zeitschrift für Physikalische Chemie 224, 33–60 (2010).
[2] Frick, B.et al., Nucl Instrum Meth A 669, 7–13 (2012).
[3] van Eijck, L. et al., Nuclear Inst. and Methods in Physics Research, A 672, 64–68 (2012). Appel, M. et al., to be published.

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