STRUCTURAL STUDIES OF SINGLE CRYSTALS AND POWDERS AT PULSED NEUTRON SOURCES

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At present, two types of neutron sources – steady-state (or continuous) and pulsed – are used for neutron scattering studies of condensed matter. Numerous nuclear reactors belong to the first type, while the second type is formed by still a few sources based on proton accelerators with heavy metal target. In turn, pulsed neutron sources are classified according to the time width of the neutron pulse, Δt_0, as short pulse (with $\Delta t_0 \leq 50$ μs) and long pulse (with $\Delta t_0 \geq 300$ μs) sources. The last is connected with the strong influence of the neutron pulse width on the resolution function of neutron spectrometers and correspondingly on the possibility to realize some kind of experiments. At both types of pulsed neutron sources a continuous neutron spectrum and the time-of-flight (TOF) technique are used for data acquisition.

Continuous neutron spectrum offers an opportunity of 3D pattern measuring if diffraction on a single crystal is studied with 2D position-sensitive detector. This makes single crystal TOF diffractometers especially powerful in applications involving surveys of reciprocal space, such as phase transitions, incommensurate structures and diffuse scattering. An example of such instrument is the SXD one operational at ISIS pulsed neutron source [1].

Neutron powder TOF diffractometers have to be optimized for a particular type of studies: crystal atomic structures (high resolution, intermediate and small *d*-spacings), long-range magnetic structures (large *d*-spacings), irreversible processes in real-time (high intensity, large *d*-range), microsamples (high intensity, low background). With TOF diffractometer in parallel with crystal structure the measurement of strains, an estimation of texture and anisotropy effects is possible and the analysis of multiphase materials is very straightforward. For long pulse neutron sources a new type of analysis – the correlation Fourier technique – has been recently successfully developed, providing extremely high *d*-spacing resolution at quite short flight path [2].

References

[1] http://www.isis.stfc.ac.uk/

[2] A.M. Balagurov, Neutron News 16, 8-12 (2005)