Investigating Fast Solid State Reactions with Time-resolved Constant Wavelength Neutron Powder Diffraction at D20

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D20 provides highest intensity in neutron powder diffraction. The incident flux on the sample reaches up to 10^8 n/s/cm^2 at 1.3 Å wavelength. A stationary, curved linear position sensitive detector covers continuously 153.6° in 2θ with 1536 cells in parallel. This makes D20 an ideal tool for *in-situ* diffraction studies with time constants even below a second and encourages the use of difficult sample environments. 4 vertically focusing monochromators, 15 take-off angles, and optional Soller collimators provide a large choice in Q-space, resolution, wavelength (0.8 to 2.4 Å), and flux, adapting D20 to various levels of crystallographic complexity and rapidity of an observed phenomenon. The continuous and simultaneous detection of series of complete diffraction patterns is necessary for the investigation of phase transitions during variation of a parameter like pressure or temperature (*thermodiffractometry*). *One-shot* experiments study the structural evolution of solids in situ during a chemical reaction with single diagrams of down to 400 ms, quantifying short-living intermediate phases and elucidating subtle structural changes. High-resolution patterns can be obtained in a few minutes at high take-off angle. Faster, cyclic phenomena are observable in a stroboscopic acquisition mode. Time resolution is limited by the travel time of neutrons through sample and detection gap, ≈ 10 µs for thermal neutrons. An oscillating radial collimator with a focus aperture of 22 mm and full angular coverage suppresses background from sample environment.

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