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MENU

D3 Reflectometer

Typical Experiments

- Neutron reflectometry on metal films
- Magnetic order in thin films and multilayers
- Growth of corrosion prevention oxides
- Polymer films and coatings

- Biological thin-films

Designed specifically for neutron reflectometry, the instrument operates in a horizontal scattering plane while the sample (i.e. the interface to be studied) is mounted vertically. The incident beam is fixed in wavelength (λ = 2.37 Å), and is focused on the sample by the vertically curved, 30 cm tall monochromator located 152.4 cm upstream from the sample. The strong focusing creates an intense image of the in-reactor neutron source on the sample with a vertical size of ~ 4.6 cm. For the experiments where the vertical focusing is not desirable, an adjustable slit allows the user to reduce the monochromator height. For polarized neutron operation, the instrument is equipped with a super-mirror polarizer. Analyzing of reflected neutron spin is currently performed with a Heusler-alloy crystal, but a long-term plan is to install a second super-mirror.

Two detectors are available, each capable of simultaneously recording specular and off-specular reflections. The first is a 32-wire detector where the wires running vertically are long enough to capture all the reflected neutrons diverging vertical after the focal point at the sample. The 2 mm spacing between the wires corresponds to Δ2θ ~ 0.1°. The second is a 2-dimensional detector (DENEX 200) with a resolution of 1.5 mm horizontally and 2 mm vertically. The horizontal resolution corresponds to Δ2θ ~ 0.06°.

The heavy-duty goniometer for supporting the sample is rated for precision alignment of a load of 725 kg. This enables field reversal reflectometry experiments with the ±7.5 T superconducting magnet, M5. For the experiments requiring a horizontal field, an electromagnet can provide 0.85 T with 60 mm gap or 1.05 T with 40 mm gap. A special low-vibration refrigerator (D6) with the temperature range 6 – 300 K is also available.

Technical Specifications

Beam Size:

- Vertically focused and ~ 50 mm high at sample position
- Horizontal width controlled by motorized S2 slit to 4 μm precision

Monochromomator:

- Vertically focused and 300 mm tall compound-mirror of (002) graphite
  - a vertically limiting slit allows trimming of height if required
  - width controlled by motorized S1 slit to 4 μm precision

Monochromator take-off Angle: Fixed at 41.39° delivering λ = 2.37 Å

Incident Polarizer: Fe/Si super-mirror in transmission geometry

Analyzer: Heusler alloy Cu2MnAl (needed only for reflected spin analysis)

Detectors:

- ^{3}He 32-wire detector (wire spacing = 2 mm)
- ^{3}He two-dimensional detector (spatial resolution = 1.5 × 2 mm)

Physical dimensions:

- source to monochromator = 200″ (5080 mm)
- monochromator to specimen = 60″ (1524 mm)
- specimen to 32-wire detector = 48″ (1220 mm) †
- specimen to 2-D detector = 53″ (1350 mm) †

†slightly larger than distance to detector face to account for extra path length in gas.