Rotating Anode X-ray Diffractometer for Thin Films

Rigaku Smartlab 9kW

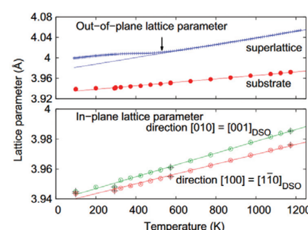
DESCRIPTION

Rigaku SmartLab 9 kW is an automatic X-ray diffractometer dedicated to characterization of thin films and nano-structures. Available non-destructive analytical techniques reveal information on crystal structure, chemical composition, and physical properties of various materials such as semiconductors, metallic layers, and insulators.
θ/θ goniometer with an in-plane arm allows large variety of X-ray diffraction and scattering techniques. Series of optical elements can be used to adapt experimental conditions for particular experiment.

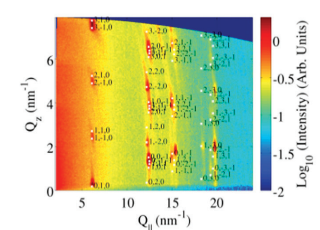
SPECIFICATION

Technique	Description
Coplanar X-ray diffraction (XRD)	Lattice parameters, lattice strain, chemical composition, inter-layer diffusion in thin films and multi-layers
Reflectivity and diffuse scattering (XRR)	Thickness of layers (~0.5–500 nm), surface and interface roughness, and roughness lateral correlations
Small angle X-ray scattering in 1D and 2D mode (SAXS)	Size distribution of particles and pores in solutions and light solid matrices, their mutual distance; size up to >≈ 100 nm
Grazing incidence small angle scattering (GISAXS)	Particles and pores size and their size distribution and mutual distance in thin films and nano-porous thin films
Grazing incidence X-ray diffraction (GIXRD)	In-plane lattice parameters and preferential crystallites orientation in thin films; depth resolved measurements
Texture (Pole figures) measurements	Distribution of preferential crystallographic orientation in thin films
Scanning micro-diffraction	Information as for techniques above with lateral resolution down to 0.2 mm on laterally inhomogeneous samples
Phase analysis and material characterisation	Crystal phases of materials, calculation of amount of present phases, crystallite size and crystallinity in thin films
In-situ measurements at high temperatures	Annealing chamber DHS1100 (9kW) allows for in-situ measurements at sample temperatures up to 1100 °C, in vacuum or in inert gas; hemispherical chamber dome allows to apply scattering techniques mentioned above
In-situ low temperature measurements	Low temperature chamber by Cold Edge Technologies with hemispherical dome allows all above experimental methods at LN or LHe cooling.
High speed 2D reciprocal space mapping	The pixel array detector HyPix-3000 with ultra-high dynamic range and high sensitivity allows for fast data acquisition of 2D reciprocal space maps; higher time resolution is achieved in real-time in-situ experiments

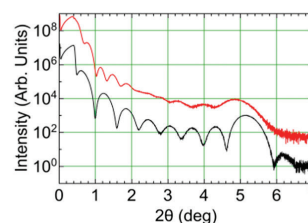
RESULTS



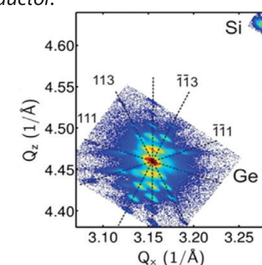
Temperature dependence of the lattice parameters in epitaxial $(BaTiO_3)_8/(SrTiO_3)_4$ Superlattice.



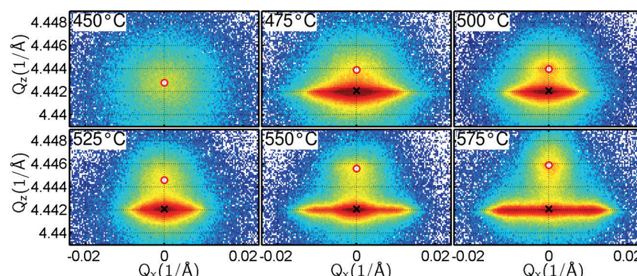
GIXRD reciprocal space map on a thin film of an organic semiconductor.



X-ray specular reflectivity on a thin film of an organic semiconductor and a similar layer with a metal electrode above.



High resolution (HR) XRD Reciprocal space map (RSM) on facetted Si/SiGe heterostructures.



HRXRD RSMs of epitaxial Ge microcrystals showing evolution of Ge peaks due to strain varying at different growth temperatures.

PUBLICATIONS

(1) Železny, V. et al. Temperature-dependent far-infrared reflectance of an epitaxial $(BaTiO_3)_8/(SrTiO_3)_4$ superlattice. *Phys. Rev. B* **95**, 214110 (2017)
(2) Gablech. I. et al. Stress-free deposition of [001] preferentially oriented titanium thin film by Kaufman ion-beam source. *Thin Solid Films* **638**, 57 (2017)
(3) Wang Ch. et al. Mid-infrared ellipsometry, Raman and X-ray diffraction studies of $Al_xGa_{1-x}N$/AlN/Si structures. *Appl. Surf. Sci.* **421**, 859–865 (2017)
(4) T. Storzer, et al. Growth, Structure, and Anisotropic Optical Properties of Difluoro-anthradithiophene Thin Films. *J. Phys. Chem. C* **121**, 21011 (2017)
(5) Rozbořil J. et al. Annealing Behavior with Thickness Hindered Nucleation in Small-Molecule Organic Semiconductor Thin Films, *Crystal Growth & Design* **19**, 3777 (2019).
(6) Falub C.V. et al. Enhanced permeability dielectric FeCo/Al2O3 multilayer thin films with tailored properties deposited by magnetron sputtering on silicon, *AIP Advances* **9**, 035243 (2019).

MORE INFO

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