Grazing Incidence Diffraction with Single Crystal Diffractometer

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The new designs of x-ray sources, x-ray optics and detectors helped to introduce state of the art single crystal (SC) diffractometers that can be successfully used not only for small molecule absolute crystal structure determination but also for the protein crystallography. The x-ray flux densities of the new micro focus sources combined with advanced x-ray optics can reach 25-35 x 10^9 ph/(s·mm^2) which rival those employing 4kW rotating anode x-ray sources. These new sources and detectors that are available on SC diffractometers can be successfully used for thin film analysis.

I will describe how single crystal diffractometer equipped with kappa goniometer can be used for Grazing Incidence Diffraction (GID) as well as for in-operando x-ray diffraction. The GID geometry combined with the high flux of the micro focus sources and 2D detectors facilitate identification and evaluation the crystalline phases, texture and residual stress in the layers that are as thin as few nm. The advantages and limitations of the GID setup on kappa-equipped SC diffractometers will be discussed.

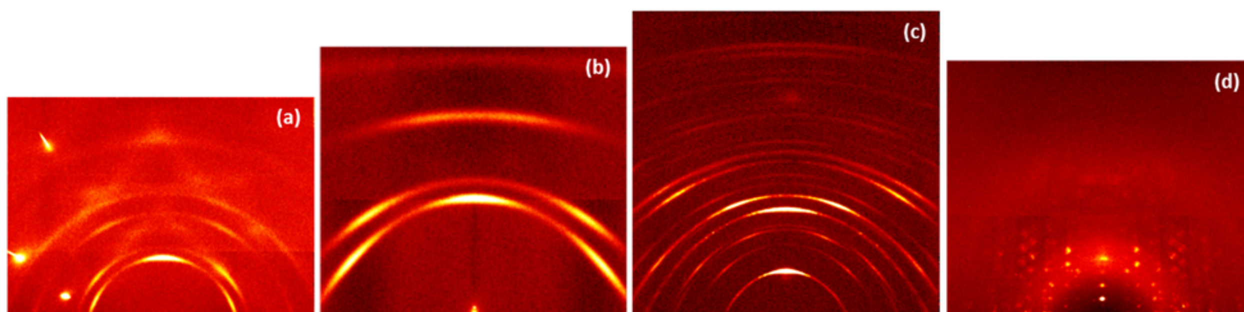

Figure 1. GID data: textured metallic film on Si wafer (a) Mo-source and (b) Cu-source; (c) textured $CH_3NH_3PbI_3$ perovskite thin film; (d) strongly textured perovskite-type thin film.