Poster

Theoretical and Experimental Investigations of X-ray Back Diffraction at Grazing Incidence

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We report our recent theoretical and experimental investigations on Grazing-Incidence X-ray Back Diffraction (GIXBD) from a highly miscut ($_m$ = 89.926°) Si (12 4 0) crystal. The unique optical characteristics of X-ray back diffraction, such as wide angular acceptance and high energy resolution, excited from a highly asymmetric-cut crystal demonstrate significant angular dispersion properties [1], leading to the development of high-resolution monochromators and analysers. [2]. We have recently calculated the 2-beam GIXBD of Si (12 4 0) [3], using a fully dynamical simulation based on the algorithm by Stetsko and Chang [4]. In this paper, the algorithm is applied to compute the complex 24-beam Si (12 4 0), in which 96 eigen modes are excited inside the crystal. Conducted at a sub-meV temporally coherent synchrotron radiation beamline, our experimental results have strongly confirmed our theoretical predictions (refer to Figure 1). The measured angular dispersion rate (ADR) 44 ± 9 µrad/meV, which traditional DuMomd analysis cannot explain, is several times larger than that of ever reported. This finding indicates a vast potential for the development of advance future X-ray optical devices.

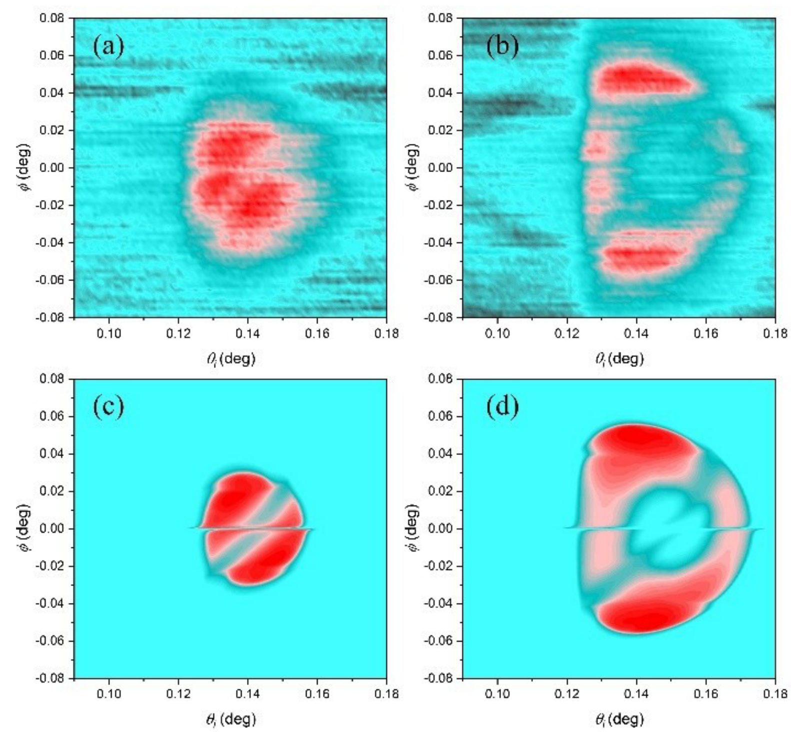

Figure 1. The intensity distribution of GIXBD at a miscut angle of 89.926°, plotted as a function of the incident angle (θ_i) and the azimuthal angle (ϕ), is shown in (a) for an incident energy of 0 meV, and in (b) for an incident energy of 4.9 meV. Fig. (c) and (d) represent the corresponding theoretical simulations based on dynamical X-ray diffraction theory.

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