X-Ray Analysis of Surface and Pseudo-Surface Acoustic Waves Propagation in Disordered $La_3Ga_5SiO_{14}$ and Ordered $Ca_3TaGa_3Si_2O_{14}$ crystals

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The process of X-ray diffraction on acoustically modulated disordered $La_3Ga_5SiO_{14}$ (LGS) and ordered $Ca_3TaGa_3Si_2O_{14}$ (CTGS) crystals was used to study the excitation and propagation of surface (SAW) and pseudo-surface acoustic waves (PSAW).

The propagation of SAW and PSAW leads to sinusoidal modulation of the crystal lattice and gives rise to diffraction satellites on the rocking curve, with the intensity and angular divergence between the diffraction satellites depending on the wavelength and amplitude of the crystal lattice acoustic modulation. Fig. 1 shows X-ray diffraction spectra of *Z*-cut of an LGS crystal modulated by $\Lambda = 6$ μm SAW with amplitude of h=3.1 Å. The analysis of diffraction spectra enables the determination of the amplitude and acoustic wavelengths, and power flow angles of acoustic energy propagation[1]. The distribution of the diffracted X-ray intensity on the crystal surface was used for mapping of SAW and PSAW propagation in LGS and CTGS crystals.

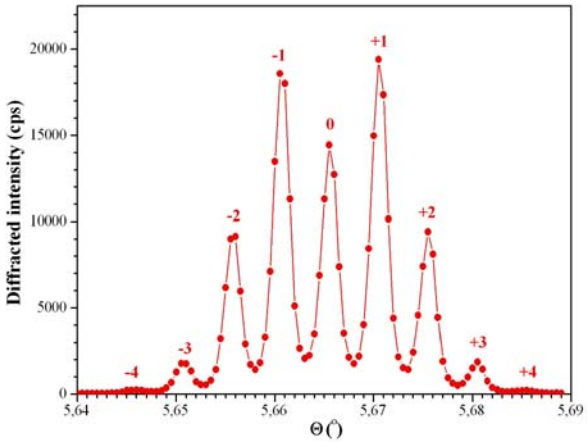

Fig. 1: X-ray diffraction by Z-cut of LGS crystal modulated by SAW with $\Lambda = 6$ μm. SAW amplitude is h=3.1 Å.

The process of SAW and PSAW excitation and propagation is strongly different in ordered and disordered crystals. The SAW and PSAW with wavelength of $\Lambda = 6$ μm were excited by the same interdigital transducer at different excitation frequencies and propagate with different velocities.

The process of the SAW and PSAW propagation in disordered crystals can be characterized by the power flow angles differed from zero. Furthermore the SAW and PSAW in disordered crystals have the different signs of power flow angles which strongly depend from the direction of SAW (PSAW) propagation on the crystal surface.

In ordered crystals the power flow angles equal to zero and SAW (PSAW) energy propagates at the direction of SAW (PSAW) wave-vector.

[1] D. Roshchupkin, L. Ortega, O. Plotitcyna, A. Erko, I. Zizak, and D. Irzhak, "X-ray diffraction study of surface acoustic waves and pseudo-surface acoustic waves propagation in $La_3Ga_{5.5}Ta_{0.5}O_{14}$ crystal", J. Appl. Phys., vol. 113, p. 144909(4), 2013.