The coherent scattering of X-ray under acoustic exposure

A.S. Gogolev, Yu.A. Popov, <u>A.R. Wagner*</u>, A.P. Potylitsyn

Tomsk Polytechnic University, Russia

* wagner@tpu.ru

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The main problem

Increasing of monochromatic X-ray beam intensity

One way - increase the intensity of the first source

Second way - improving the properties of X-ray optics

Purpose of research

 Research of increasing the reflectivity of the quartz crystal with excitation of the acoustic waves

Experiment

- X-ray source is pulsed X-ray tube with tungsten anode XRA-160-5.
- Voltage and average current were 60 kV and 1 mA, respectively
- Radiation is scattered on the quartz crystals X-cut, diameter 15 mm and thicknesses 1 mm
- We studied the reflections from atomic planes oriented perpendicular to the large surface of the samples (10-11), the distance between planes d = 3,3429 Å

Experimental setup



 $\theta_{\rm D}$ – detection angle , $\Delta \theta_{\rm B}$ = 5 mrad, $\theta_{\rm D}$ – detection angle , $\Delta \theta_{\rm D}$ = 10 mrad)







• Observed $L_{\beta 1}$ -line of Tungsten (9.671 keV), for which the Bragg angle is the value 11,09°

• The radiation was detected in the symmetric Laue geometry by scintillation detector (NaI)

For the excitation of ultrasound in the quartz used generator of electrical sinusoidal pulses with the possibility of smooth variation of the amplitude from 0 to 10 V and frequency from 1 Hz to 25 MHz and amplifier (frequency range of 1-10 MHz, amplitude 1-50 V).

Results



Intensity vs generator voltage and linear amplification factor



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Intensity vs Crystal orientation angle



Experimental setup



Radiation with energies of 20 keV, which corresponded to the Bragg angle $\theta_B = 5,44$ ° for reflection (10-11), registered in symmetrical Laue geometry by semiconductor detector (BDER-KI-11K) at an angle of 10,88 °, respectively, at a distance from the crystal monochromator 300 mm.

Diffraction X-Ray spectrum



... a drop of theory...





The dependence of diffracted intensity (1) and passing X-ray beam intensity (2) on the external effects $A = hU_0/2$



Rocking curves for different values of the external exposure



1 - A = 0, 2 - A = 1000, 3 - A = 10000, 4 - A = 8000

Conclusion

- The experimental results showed the ability to control reflective quartz crystals and correspond to the theory
- The intensity of the diffracted beam to increase in 2 times

Abstract...

... In the symmetrical Laue geometry the increase of reflex (10-11) intensity in 16 times was obtained. The maximal amplification was obtained for the voltage equal to 40 V...



In perspective...

 Approbation of the technique for a project "Source of monochromatic X-rays on the betatron" (Thursday, 7, October Yuri Adischev)

LABORATORY "PHOTON"

I INVITE YOU TO OUR COLLABORATION WITH YOUR POTENTIAL...

Channeling 2010, 3 - 8 October

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Many thanks ...

- A.R. Mkrtchyan and colleagues for stimulating discussions
- You for attention...

Calibration of detector by 241Am

