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PXR: estimations for the maxima intensity and temperature dependence

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The work is devoted to features of parametric X-ray radiation - PXR. On the base of the results obtained in [1] and [2] (and confirmed experimentally in [3]), it is noted that the dependence of maximum intensity on electrons energy for PXR and PXR at channeling (PXRC) is very different. The cause is in band structure of energy levels transverse motion. The relative difference between the intensities of the PXR and PXRC has sharp jumps. Such unusual kind of the theoretical dependence of the relative difference between PXR and PXRC means that even from the theoretical point of view the PXRC intensity measurements will necessarily have scattered values (in contrast to PXR) –for (110) Si –up to 5%

Two approximate formulas were obtained for calculation of PXR intensity maximums. The errors of these formulas do not exceed 2.5 % and 1.2 % respectively.

For Fourier-components of susceptibility χ_0 and $\chi_{g\sigma}$ of Si crystal simple formulas are obtained by fitting of data from [4]. These formulas allow calculate χ_0 and $\chi_{g\sigma}$ with sufficient precision for a wide range of frequencies.

Using Debye theory we have took into account the temperature dependence of Fourier components of susceptibility what have led to a small change in PXR intensity. For the range of temperatures of the crystal from 100 K to 1000 K, the intensity variation will not exceed: 3% for T = 100 K and 10% for T = 1000 K.

If we take into account change of PXR-photon energy (due to the change of the lattice constant with temperature), for the range of the crystal temperatures from 100 K to 700 K PXR intensity change is very noticeable ~ 86%.

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