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X-RAY SPECTRAL DECOMPOSITION IN THE ~ 10 keV ENERGY RANGE BY WAY OF REFRACTION BY A POLISHED DIAMOND PLATE

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We have shown that the dispersion properties of diamond provide an effective spatial separation of characteristic X-ray lines with photon energies of ~ 10 keV in the reflection of the radiation by the edge of a polished plate in the range of grazing angles below 1°. This makes it possible to analyze the spectrum of directional beams from continuous and pulsed radiation sources and monochromatize the spectrum in measuring schemes where thin ribbon-shaped beams are involved.

To analyze the spectral composition of $\sim 10\,keV$ radiation and to monochromatize it, in most cases advantage is taken of perfect monocrystals of Si, Ge, LiF, quartz, and other materials [1, 2]. The attained energy resolution δE is usually between 1 and 10 eV. A resolution of $\sim 1\,meV$ may be reached with the use of several sequential reflections from asymmetrically arranged crystals [3]. However, these ultrahigh monochromatization schemes are only used with synchrotron radiation because they require a high spectral radiation density. For many X-ray diagnostic methods related to the phase analysis of polycrystalline structures, small-angle scattering, X-ray reflectometry, and X-ray fluorescence analysis, the energy resolution afforded by crystal monochromators is in fact excessive and therefore results in a significant loss in luminosity.

Here, we show for the first time that the X-ray optical properties of diamond provide, under specific irradiation conditions, an effective spectral decomposition of a polychromatic X-ray beam, which can be used to advantage in the above X-ray diagnostic methods.

Let a parallel monochromatic X-ray beam with a wavelength λ and a photon flux P_0 be incident at an angle close to $\pi/2$ on a side face of an optically polished plate with a