Bragg diffraction transmission microscopy using highly monochromatic x-rays

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Imaging of the strain field in the diamond crystal lattice was performed in backscattering of highly monochromatic (photon energy bandwidth dE ~ 1 meV) x-rays at a photon energy of E = 23.7 keV [1-4]. Quantitative information on the strain distribution was extracted from a sequence of images of the transmitted x-ray beam while scanning the energy of the incident x-rays through the reflectivity curve of a high-indexed diamond backreflection. The use of transmission geometry is advantageous since the area detector can be placed close to the sample, which prevents geometric blurring of the images. Previous work on x-ray topography of diamond crystals in the Bragg diffraction transmission mode [5] reports on characterization of mounting-induced strain at the level of 10^{-6} . In our work the use of photon-energy-tunable highly monochromatic x-rays in backscattering in combination with methods of sequential topography permits direct mapping of small relative changes (down to 10^{-8}) in the lattice parameter. The obtained micrographs of the strain field could be used for ultra-precise quantitative characterization of defect states in the crystal lattice and possibly their evolution as a function of external parameters (temperature, pressure, electromagnetic field, etc.).

References

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