Strain Tensor Measurement in Crystals Using the EBSD Technique

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The advantages of Kikuchi method (EBSD technique) such as high locality (~ 40μm) and precision of lattice parameter determination (~10^{-4} Å) have been used to develop the enhanced technique of residual strain tensor construction by means of new approaches.

In traditional procedures of determination of strain tensor components as a rule one of the components is being undetermined. Precise determination of position of zone axes on the Kikuchi pattern is complex and ambiguous task since the fragment of pattern around the area of Kikuchi bands intersection has no intensity maximum; moreover, intensity distribution has no symmetry. To solve this task the complex of methods for digital processing of EBSD patterns have been proposed and allow to determine not only the exact position of zone axis but also to analyze the profiles of intensity distribution across Kikuchi bands [1, 2]. To specify all components of strain tensor unambiguously it has been proposed to determine the diagonal components of strain tensor from the changes of integral intensity of Kikuchi bands.

Approbation of developed technique was carried out on diamonds samples, diamond films, metal sheets (Ni, Al), nanocrystalline metal films, weld joint of NiCrFe nickel alloy with crack. It should be noted that extended precision of strain tensor components can be achieved using the reference crystal.

Characteristic surfaces of strain tensor and strain ellipsoids were constructed for local areas, which demonstrably show the anisotropy in the distribution of residual strains. Particularly in the case of diamond crystal shear components of strain tensor ε_{xz}, ε_{yz} for local areas, which correspond to different crystalline blocks, have almost equal values that indicate the absence of rotation in reference crystallographic directions. At the same time other components of strain tensor show significant variations.

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2. Borcha M.D. Balovsyak S.V., Fodchuk I.M., Khomenko V.Yu., Tkach V.N. Distribution of Local Deformations in Diamond Crystals according to the Analysis of Kikuchi Lines Profile Intensities // Journal of Superhard Materials. – 2013. – Vol. **35**, №. 4. – pp. 35–43.