Automated phase determination through detection of symmetry elements in EBSD patterns.

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Electron Backscatter Diffraction (EBSD) is used almost entirely for the mapping of crystal orientation (OIM)[1] or for mapping of crystal phase (CPM)[2]. More recently it has been adapted for the mapping of the elastic strain tensor (ESM)[3] and the dislocation tensor (DTM)[4,5]. This new work describes a further adaptation of the EBSD technique as a potential tool for crystal phase determination. Crystal phase determination differs from crystal phase discrimination which is the basis of the CPM method as it is applicable in cases where there are ambiguities or indeterminacy in the CPM method and in all cases where the crystal phase has not been previously observed or recorded. The new process can be distilled into three steps: (1) extracting a triclinic cell from a single EBSD pattern, (2) identifying the crystal symmetry from an examination of the triclinic cell, and (3) determining the lattice parameters. The triclinic cell is determined by finding the bands passing through two zone axes in the pattern including a band connecting the two. A three dimensional triclinic unit cell is constructed based on the identified bands. The EBSD pattern is indexed in terms of the triclinic cell thus formed and the crystal orientation calculated. The pattern indexing results in independent multiple orientations due to the symmetry the crystal actually possesses. By examining the relationships between these multiple orientations, the crystal system is established. By comparing simulated Kikuchi bands with the pattern the lattice parameters can be determined. Details of the method are given for a test case of EBSD patterns obtained from the hexagonal phase of titanium.

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