Three-dimensional microstructural analysis for novel TRIP steels by SEM-EBSD/FIB.

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Three-dimensional (3D) microstructural analysis has become very important to understand the mechanical properties of novel Transformation Induced Plasticity (TRIP) steels because their microstructures tend to be finer and more complex. Material properties of these TRIP steels are influenced by microstructural information such as γ morphology, crystal orientation relationships between Φ#177; and γ and so on. We have investigated a serial sectioning technique using combination of a scanning electron microscope (SEM) equipped with an electron backscatter diffraction (EBSD) and a focused ion beam (FIB) to reconstruct 3D microstructure of TRIP steels. In this work, dependences of FIB and SEM condition on the structure are presented in a TRIP steel and γ-grains stabilities are discussed in terms of ion beam effects.

3D-SEM images are successfully obtained using a backscattered electron detector for 20 μm cube with optimizing imaging conditions although the identification of each phase is difficult. 3D-EBSD analysis provides clear Φ#177;-grains maps for the volume of several μm cube, however γ-grains are not recognized by 3D-EBSD map using FIB at the normal ion accelerating voltage of 30 kV. This phenomena is caused that γ-grains are easily transformed into martensite due to ion irradiation during FIB fabrication. It is found that decreasing the ion accelerating voltage prevents the ion-induced transformation of γ-grains. 3D γ-grains map was successfully obtained in lath matrix region under this specific the FIB conditions. It becomes possible to evaluate morphology of each phase and the crystallographic relationship between Φ#177; and γ-phases through this technique.