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IT-9-P-2531 Determination of dislocation density by electron backscattering diffraction and X-ray line profile analysis in ferrous lath martensite

Berecz T.[1], Csóré A.[1], Jenei P.[2], Gubicza J.[2], Szabó P. J.[1]

[1]Department of Material Science and Engineering, Budapest University of Technology and Economics, Budapest, Hungary, [2]Department of Materials Physics, Eötvös Lóránd University, Budapest, Hungary

Email of the presenting author: berecz@eik.bme.hu

Ferrous martensite can appear in several forms, such as lath, lenticular and plate, depending mainly on the composition. Among these martensite structures the lath martensite has high industrial significance because of its high strength and toughness. Lath martensite can appear usually in the technologically more important low (and medium) carbon, low cost and low alloyed steels.

The lath martensite morphology exhibits a characteristic multilevel microstructure. A parent austenite grain consists of several packets (the group of laths with the same habit plane). Each packet is divided into parallel blocks and a block is further subdivided into laths. The size of individual martensite laths is very small, therefore they cannot be seen by optical microscopes. There are high angle boundaries between the blocks and packets, while low angle (about 5-10°) boundaries between the single laths.

The strength and toughness of the lath martensitic steels strongly depend on the microstructure through packet and block sizes, as well as the size, shape and arrangement of the laths. The reason of their high strength and toughness is mainly the high angle boundaries between the blocks and packets which hinder the dislocation movements.

Dislocation density in the lath martensitic structure can be determined by both automated electron backscattering diffraction (EBSD) and X-ray line profile analysis (XLPA) method. Dislocations can cause local lattice distortion, which leads to misorientation between individual points in the lattice. Using automated EBSD, the local orientations are determined at individual points in a regular grid on a planar surface of a polycrystalline specimen.

From the difference between the neighboring orientations on planar surfaces the dislocation density can be calculated. XLPA is sensitive to microstrains around the individual dislocations, even if the dislocations are arranged into such configurations which do not yield any misorientation between the different volumes of the crystal. Thus, the dislocation density calculated by XLPA may be different from that measured by automated EBSD.

In our study dislocation densities are determined in individual laths and blocks by EBSD and these results are compared with the dislocation density measured by XRD in ferrous lath martensite.

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