Microsc. Microanal. 8 (Suppl. 2), 2002
DOI 10.1017.S1431927602106507

EBSD Study of Martensite in a Dual Phase Steel

Bong-Yong Jeong, R.Gauvin and S.Yue

Department of Mining, Metals and Materials Engineering, McGill University, 3610 University St. Montreal, Quebec, H3A 2B2, Canada

Dual phase steel microstructures are predominantly equiaxed ferrite with martensite volume fractions varying from about 10 to 20%. The steel for this study is a plain low carbon (0.09%C) grade, donated by Ivaco, Canada. The dual phase structure was generated by annealing at a temperature of 750 ^{o}C (i.e. in the two phase austenite plus ferrite region), followed by a water quench after a hold time of 5 minutes, to transform the austenite to martensite. After mounting, the specimens were mechanically polished using SiC, 1 μm diamond paste and 0.05 μm colloidal silica, in succession. To obtain the EBSD data, a Philips XL-30 FEG with TSL orientation imaging system was used.

In multiphase steels, phases can be classified using image quality of the EBSD pattern [1,2]. If the crystal lattice is distorted due to strain, then the corresponding diffraction pattern will be more diffuse than that from an undistorted crystal lattice. Figure 1 shows the image quality (IQ) map of the dual phase steel. In the microstructure, the black regions correspond to the very low quality of the EBSD patterns at those areas. In dual phase steels, the formation of martensite in a matrix of ferrite causes a high local dislocation density and high residual stresses. This figure clearly shows the martensite islands in the ferrite matrix by EBSD technique.

These steels were also subjected to a very slow cool from 750^{o}C to transform the austenite to pearlite instead of martensite The IQ map of the pearlite island in the ferrite matrix is shown in Figure 2. By comparing the two IQ maps (Fig. 1 and 2), it is apparent that the EBSD pattern quality of pearlite is higher than that of martensite. It means that distortions of the crystal lattice within the martensite are greater than that of the pearlite. This result clearly shows that the IQ map is useful for gaining some insight into the distribution of strain in a microstructure.

Figure 3 is an IQ value profile of the dual phase steel across the martensite island in the ferrite matrix. This result quantifies IQ value difference between ferrite and martensite, and shows some fluctuations of the IQ within the martensite.

In order to observe the response of this structure to plastic deformation, Figure 4 shows the IQ map of the dual phase steel, which has been cold rolled to a 30% reduction. The dark lines are likely dislocation rich walls or deformation bands. The characteristics of these lines seem to differ when comparing the martensite/ferrite interface with regions away from the interface. The details of this behaviour are being explored.

References

[1] M.P. Black and R.L. Higginson, Scripta Mater. 41, (1999) 125.
[2] A.W. Wilson, J.D. Madison and G. Spanos, Scripta Mater. 45, (2001) 1335.

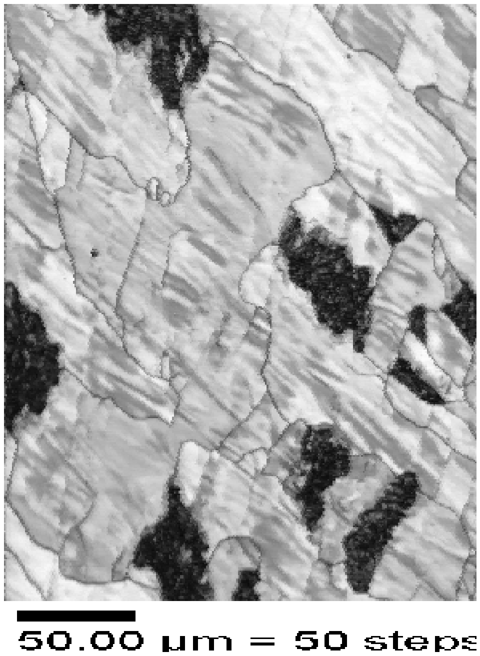

Fig. 1. IQ map of the dual phase steel, where the black areas corresponds to the low quality of the EBSD patterns. The black regions stand for martensite, and the gray and/or white regions are ferrite matrix.

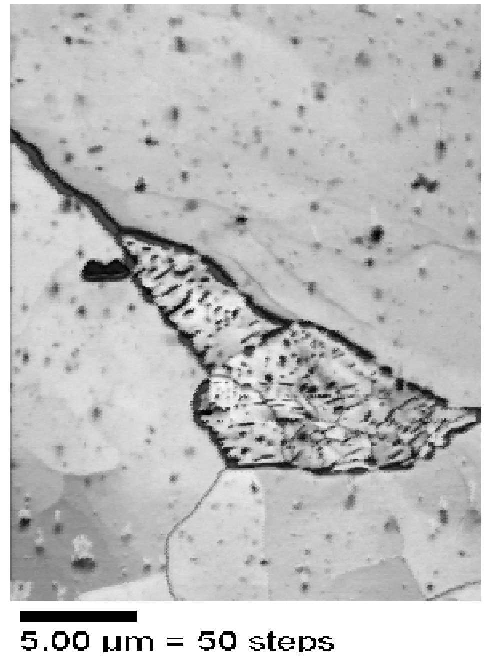

Fig. 2. IQ map of the dual phase steel, where the island is pearlite in a ferrite matrix.

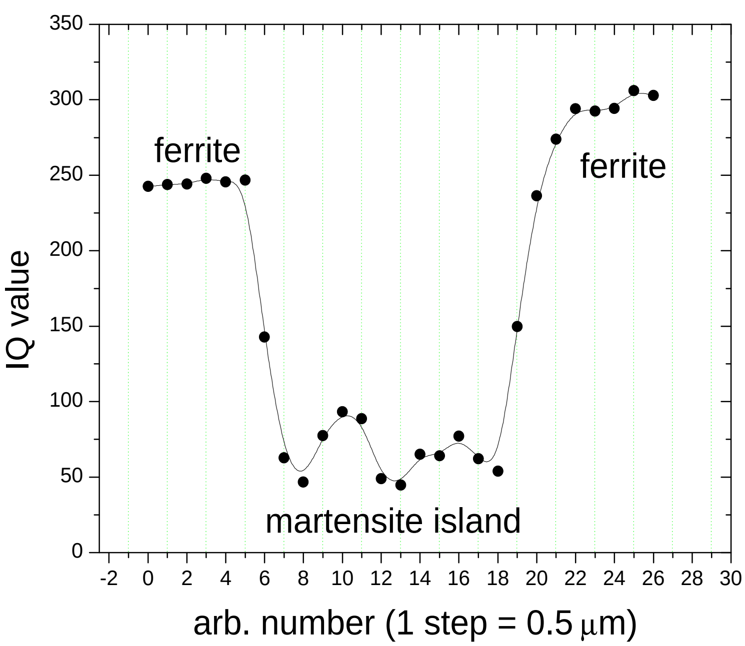

Fig. 3. IQ value profile for the dual phase steel across the martensite island in the ferrite matrix.

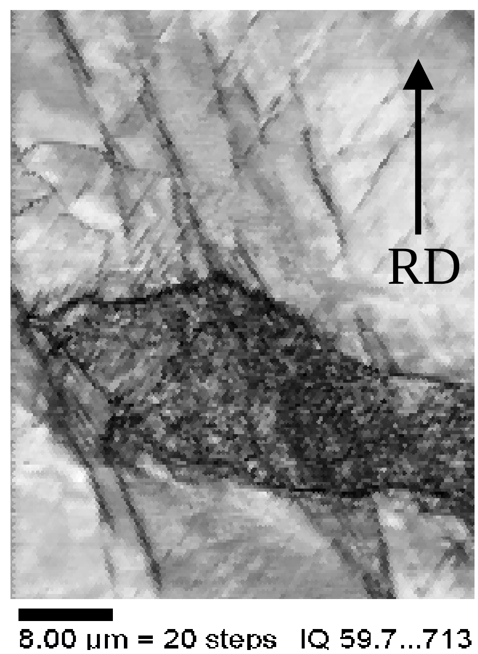

Fig. 4. IQ map of the 30% cold rolled dual phase steel, where the black region is martensite.

https://doi.org/10.1017/S1431927602106507 Published online by Cambridge University Press