Martensite and twin in $Fe_{50}Mn_{30}Co_{10}Cr_{10}$ high entropy alloy

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High entropy alloys (HEA) are commonly defined as alloys containing several principal elements in a solid solution matrix owing to high configurational entropies [1]. A representative non-equiatomic transformation induced plasticity (TRIP) high entropy alloy is $Fe_{50}Mn_{30}Co_{10}Cr_{10}$. This alloy has a low stacking fault energy and displays both high strength and good formability at ambient temperature deformation, which was attributed to the formation of martensite during the plastic deformation process [2-3]. However, an intensive investigation on the microstructure evolution, especially at the atomic scale, associated with the mechanical performance during deformation remains deficient.

By means of quasi-in-situ electron back-scattered diffraction (EBSD) we observed the formation and thickening of martensite plates in the $Fe_{50}Mn_{30}Co_{10}Cr_{10}$ high entropy alloy during compression at room temperature, Fig. 1. Furthermore, when characterizing microstructures at the atomic level using aberration-corrected scanning transmission electron microscopy (STEM), we noticed that the thickness of most martensite plates in samples compressed by 40% was in the range from several to tens of nanometers, Fig. 2, which was definitely beyond the detectability of EBSD. In other words, the volume fraction of martensite counted by the EBSD might be underestimated to a certain degree. In addition to the martensite, a number of twins with nano-scale thickness were also observed in the matrix after the compression.

References

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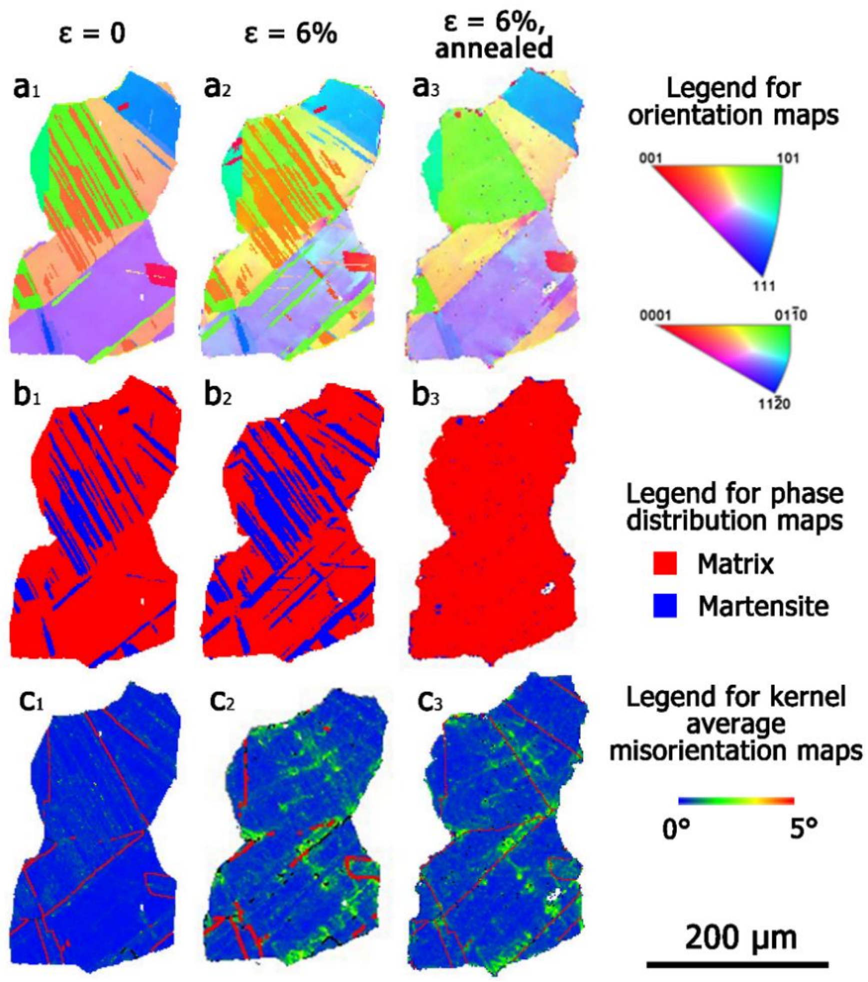

Fig. 1. *Quasi-in-situ* EBSD maps showing microstructures of (a_1-c_1) as-received, (a_2-c_2) after 6% deformation and (a_3-c_3) after 6% deformation and annealing states: (a) inverse pole figures, (b) phase distribution maps, and (c) kernel average misorientation maps, red lines represent for twin boundaries.

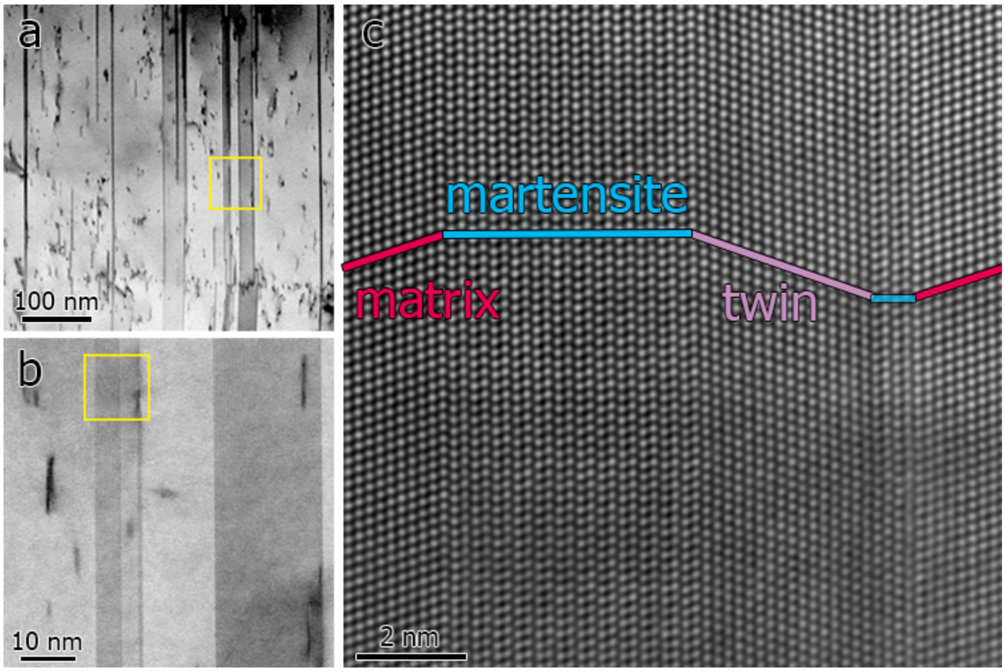

Fig. 2. (a-b) Annular bright-field STEM images and (c) zoom-in high-angle annular dark-field STEM images showing martensite and twin in the HEA after 40% compression.