Type of presentation: Poster

MS-9-P-1801 EBSD Characterization of Stress-Induced ω Phase and Twinning in Metastable β Ti-V Alloys

Wang X.[1], Xing H.[1], Sun J.[1]

[1]Shanghai Key Laboratory of Advanced High-temperature Materials and Precision Forming, School of Materials Science and Engineering, Shanghai Jiaotong University, Shanghai 200240, PR China

Email of the presenting author: jsun@sjtu.edu.cn

Recently, stress-induced products such as α″, ω phase and twinning and their effect on mechanical properties of titanium base alloys have attracted considerable attention. It has been revealed that the structural stability of the β phase significantly influences the plastic deformation mode in metastable β-Ti based alloys. In this work, stress-induced products in a series of metastable β-type Ti-xV (x=16, 18 and 20 wt%) binary alloys after tensile tests were characterized by EBSD. The stress-induced ω phase and twinning and their corresponding Schmid factors were correlated with the structural stability of the Ti-V binary alloys.

The β-type Ti-xV (x=16, 18 and 20 wt%) binary alloys were prepared by arc melting in vacuum and were hot-rolled and subjected to solution treatment at 1123 K followed by water quenching. The initial microstructure of Ti-V binary alloys is single β phase. They were tensile-tested at room temperature and a strain rate of 2×10^{-4} s^{-1}. The samples for EBSD measurements were electro-polished in a solution of 5% perchloric acid and 95% methanol at −30 °C and 50 V. The tensile direction of samples was set to be parallel to the RD in EBSD measurements. The EBSD maps were taken by JEOL 7000F SEM equipped with Oxford HKL. Fig. 1(a, b) are the EBSD orientation and phase maps of Ti-16V alloy, respectively. Many stress-induced plate-like features can be observed within grains and identified as stress-induced ω phase. The habit plane of ω phase is $\{-5502\}_{\omega}//\{332\}_{\beta}$ determined by the lattice correlation boundary method. Supposing the activated growth direction of ω phase is {332}<113> in the β phase, the corresponding Schmid factors fall into a range between 0.44 and 0.48 as shown in Fig. 1(c). Fig. 2 (a, b) are the orientation and phase maps of Ti-18V alloy. The plates with mis-orientation angle of 50.5° along the <110> direction correspond to {332}<113> twins in the β phase. Additionally, stress-induced ω phases can be observed in the grain. Fig. 2(c) shows that the Schmid factors of {332}<113> deformation twins are between 0.43 and 0.50 and stress-induced ω phase is 0.47. The deformation twins are activated easily in comparison with stress-induced ω phase. Fig. 3(a) shows the orientation map of Ti-20V alloy, where all the plates were identified as {332}<113> deformation twins. The Schmid factors of {332}<113> twins are between 0.44 and 0.46 as shown in Fig. 3(b).The structural stability of β phase increases with increasing the content of V in Ti-xV binary alloys. Based on EBSD results, it can be concluded that the plastic deformation mechanism transforms from stress-induced ω phase to {332}<113> deformation twinning with increasing of the structural stability of β phase in Ti-xV binary alloys.

Acknowledgement: This research is financially supported by the NSFC under Contract no. 51371113 and 51101099 and by the STCSM under Contract no. 13dz2260300.

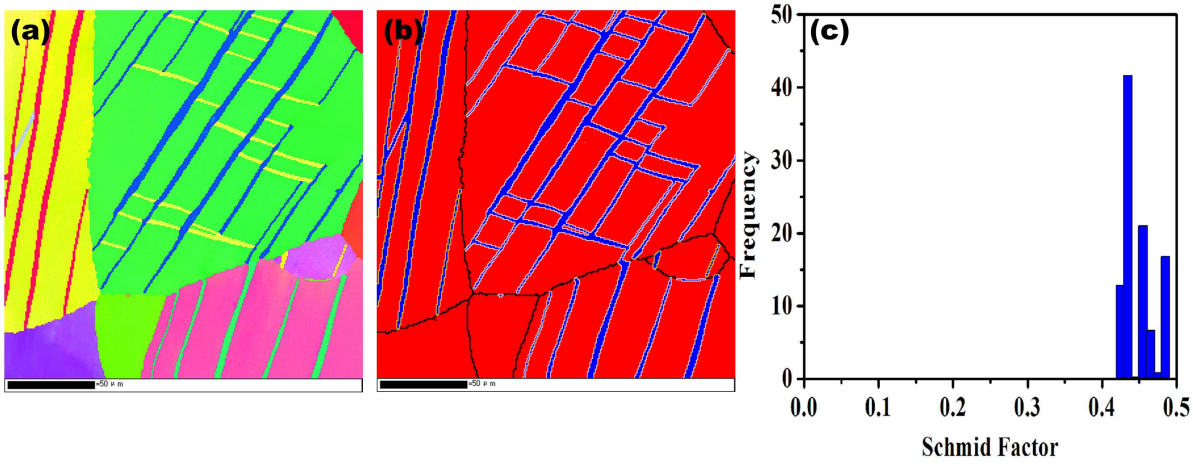

Fig. 1: Fig. 1 EBSD orientation map (a), phase map (b) and Schmid factors (c) of Ti-16V alloy.

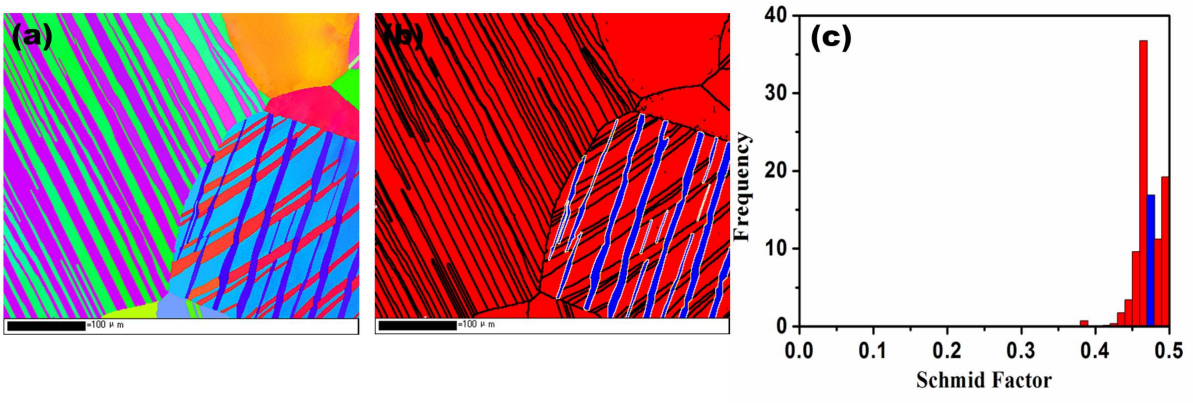

Fig. 2: Fig. 2 EBSD orientation map (a), phase map (b) and Schmid factors (c) of Ti-18V alloy.

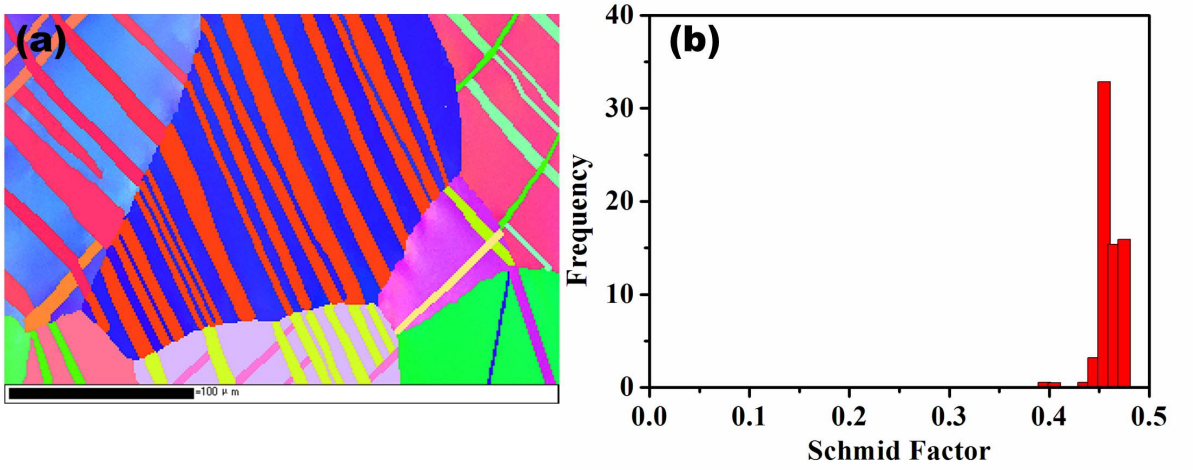

Fig. 3: Fig. 3 EBSD orientation map (a) and Schmid factors (b) of Ti-20V alloy.