Poster Presentation

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Structural characterization of phases at Nano-Scale in Ti-Alloys using TEM

Partha Ghosal[1], Rajdeep Sarkar[1], Vajinder Singh[1]
[1]*Electron Microscopy, DMRL / DRDO- Hyderabad, Hyderabad, India*
E-mail: dr.parthaghosal@gmail.com

Electron diffraction is one of the signature tools for phase determination or solving crystal structure of materials. Now-a-days, usage of precession electron diffraction has made this tool more versatile and accurate for phase identification. In this study, two different examples have been presented for characterization of phases using electron diffraction. In the first case, a new face-centered-cubic phase was identified in a metastable beta-titanium alloy (Ti-15V-3Cr-3Sn-3Al). The alloy was solution treated above beta-transus temperature followed by water quenching and ageing at 600oC to have equilibrium alpha-beta structure. The face-centered-cubic phase was found inside close-packed-hexagonal alpha-phase having an orientation relationship with alpha-phase. This new phase could be observed only in thin foils used for transmission electron microscopy. Presence of the FCC phase in titanium alloy has been observed by some earlier researchers. But, this was mostly noticed in beta-phase or at the alpha-beta interface unlike of present case and was reported to be formed as artifacts. These artifacts are generally formed due to stress relaxations in thin foils or due to hydrogen pick up during sample preparation. In this investigation, detail characterizations were carried out to show that the formation of the FCC phase in alpha-phase was not due to sample preparation.

In another study, the effect of minor elements and microstructure on steady state creep deformation has been studied in a γ-TiAl alloy (Ti-45Al-8Ta-2Cr-0.2B-0.2C) having γ+α2 lamellar structure. Precession electron diffraction (PED) was used to identify the phases, TiAl (L1O), Ti3Al (D019), TiB (orthorhombic), β/B2 and τ (B82), present in the alloy. The transformation of τ (B82) phase occurs from the B2 phase. The phase analysis clearly shows the volume fraction of B2 phase decreases with increase in τ phase. Further, the formation of coarse and fine lath was clearly observed after creep compression in virtual bright field image and orientation image of γ-TiAl and Ti3Al. Use of PED was essential to characterize the submicron sized laths and particles of Ti3Al and τ phases as these were not possible to identify using EBSD in SEM. The understanding of the phases and the micro-structural evolution was important to correlate the structure with mechanical properties of the experimental alloy.

This specialized and new technique of precession electron diffraction, clearly demonstrate its capability to determine crystal structure very precisely and to identify the smaller phases and precipitates with greater accuracy.

Keywords: Nano-phase, Ti-alloy, Electron-Diffraction