Mechanisms of Electroplasticity in α-Ti

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Abstract: It has long been known that the application of a pulsed current may significantly enhance the ductility of a metal [1]. However, the detailed mechanisms of this *electroplasticity* have been difficult to separate from the simple influence of Joule heating. In this work [2] we studied electroplastic deformation of Ti-7Al. Using this alloy allows us to decouple Joule heating from other effects since, contrary to most metals, its ductility decreases as temperature is raised above ambient. The research results show that the enhancement of ductility on current pulsing Ti-7Al is primarily due to a dramatic change in the microstructural deformation pattern. The pronounced planar slip that develops in α-Ti at ambient temperature and limits its ductility is replaced by a diffuse pattern of dislocations with a wavy morphology that is supplemented by enhanced twining at higher strain. The deformation pattern closely resembles the one that develops in this alloy at cryogenic temperature, where it has excellent ductility. The pulsed current has a dramatically different effect from that of an equivalent steady current. The steady current exaggerates planar slip with a concomitant further loss of ductility. Possible sources of this behavior will be discussed,

Keywords: electroplasticity, ductility, titanium, Ti-7Al, deformation pattern

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