INTERFACE SLIDING AND MIGRATION IN AN ULTRAFINE LAMELLAR STRUCTURE

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It has been reported previously that the mobility of interfacial dislocations can play a crucial role in the creep deformation behavior of ultrafine lamellar TiAl. Since the operation of lattice dislocations within refined α_2 and γ lamellae is largely restricted, the motion of interfacial dislocations becomes the major strain carrier for plasticity. Results of ex-situ TEM investigation have revealed the occurrence of interface sliding in low-stress (***LS***) creep regime and deformation twinning in high-stress (***HS***) creep regime. These results have led us to propose that interface sliding associated with a viscous glide of pre-existing interfacial dislocations is the predominant creep mechanism in ***LS*** regime and interface-activated deformation twinning in γ lamellae is the predominant creep mechanism in ***HS*** regime. Stress concentration resulted from the pileup of interfacial dislocations is suggested to be the cause for the interface-activated deformation twinning. Accordingly, the creep resistance of refined lamellar TiAl is considered to depend greatly on the cooperative motion of interfacial dislocations, which in turn may solely be controlled and hindered by the interfacial segregation of solute atoms (such as W) or interfacial precipitation. Furthermore, through the in-situ TEM investigation, we also found that the lamellar interfaces could migrate directly through the cooperative motion of interfacial dislocations. That is, the γ/γ and γ/α_2 interfaces can migrate through interface sliding and lead to the coalescence or shrinkage of constituent lamellae (i.e. microstructural instability), which results in a weakening effect when refined lamellar TiAl is employed for engineering applications. Although it is anticipated that interface sliding and migration are prevalent at elevated temperatures, the present in-situ straining study reveals the instability of lamellar interfaces at ambient temperatures.

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