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Interface Sliding in α/β Titanium Alloys: Activation Mechanisms and Plastic Response

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Room temperature interface sliding in the α/β titanium alloy Ti-407 has recently been reported [1]. Through in-situ straining in the SEM, interface sliding was found to occur at the onset of plasticity, with activation in additional grains as deformation proceeded. A high Schmid Factor for <a> type prismatic slip was associated with this event, especially at early stages of plasticity. Specifically, $<a_2>$ prismatic slip was found to be responsible for the activation of interface sliding. Notably, large strain gradients were observed in response to this mechanism, leading to the local generation of a high density of prismatic $<a_1>$ type GNDs adjacent to the sliding interface, determined via high-resolution EBSD and confirmed with TEM. A typical substructure at low strains is shown in Fig. 1. Poor alignment of slip systems between neighboring α-colonies, and thus lack of slip transfer, was found to be correlated with initial activation of interface sliding. It was concluded that this mechanism provides relaxation of intergranular strain incompatibilities, aiding in the increased uniform elongation of this alloy. Ultimately, interface sliding, and the concomitant response, was found to be controlled by the strength of the α-phase, which was explored through the systematic variation of Al-content, leading to a predictive pathway for exploitation of this mechanism.

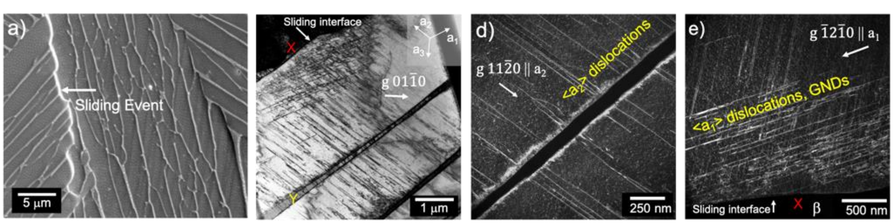

Figure 1: Sliding event in (a), the two responsible glide systems in the BF image of (b) and corresponding WBDF images of the $<a_2>$ system and $<a_1>$ system in (d) and (e), respectively.

References:

[1] Kloenne et al., Scripta Mater., 178, 2020, 418-421