EFFECT OF GRAIN BOUNDARY MICROSTRUCTURAL FEATURES ON THE FRACTURE BEHAVIOR OF AL-LI ALLOYS

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Commercial Al-Li-Cu alloys are highly desirable candidate for aircraft components because of their lower density, higher stiffness and high strength as compared to conventional Al alloys. These alloys, however, have low fracture toughness and exhibit brittle intergranular fracture. It is, therefore, important to understand the fracture behavior to design better Al-Li alloys for future aircraft systems. The critical issue is to understand the nature of grain boundary phases and their interfacial characteristics, as these characteristics dictate the fracture toughness of Al-Li alloys, and also to determine the localized dissolution characteristics of grain boundary intermetallic phases at nanoscale. Using transmission electron microscopy (TEM) and density functional theory (DFT) simulations, we recently demonstrated for Al-Cu-Li alloys the failure is likely to occur at the grain boundary T1/matrix interfaces, as these interfaces have low decohesion energies. It was reported that the toughness of the third generation Al-Li alloys has been significantly improved by reducing Li content and by adding small amounts of Ag and Mg. There are unresolved questions as to how Ag and Mg modify the interfacial characteristics of grain boundary/matrix interfaces. We will discuss the microstructure and interfacial characteristics of grain boundary precipitates/matrix interfaces, and correlate with the observed fracture behavior of third generation Al-Li alloys.