NEW ALUMINUM ALLOY DESIGN

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Since 1920's, most commercial alloys of aluminum, titanium and steels were designed for improvement in monotonic properties like yield stress (YS), ultimate tensile strength (UTS), and tensile elongation to failure (e_f), which is often reported in percentage (e_f%). In the 1950's, when the fracture mechanics concepts were introduced in design, the companies changed their alloy design to include fracture toughness (K_{Ic}) properties that represents resistance to fracture of a cracked part that is independent of component geometry. When an alloy has low K_{Ic} the material is rather brittle with low e_f%. In designing alloys reference to fatigue and corrosion has been overlooked for many decades. Thus, the alloys were always designed for static properties like YS, UTS, e% and K_{Ic}. This philosophy has resulted in expensive increased maintenance using non-destructive inspection (NDI) technologies and penalizes safety of vehicles. In order to increase safety and reduce maintenance cost, one has to focus on the region BELOW the NDI limit to monitor/mitigate the formation and growth of cracks such that the period of controlled/monitored growth of the crack is significantly longer with respect to the total life. Thus, designing alloys for crack nucleation mechanism and its early growth became important for improving component design for safety. This observation led us to think about designing alloys from the standpoint of usage in a dynamic service environment that consists of both load and chemical environment.

In this presentation, we discuss and approach to designing alloys with nano scale dispersoids and grain size with no solutes that can produce grain high strength comparable to the current aircraft alloys. Lacking precipitates in such an alloy design helps in reducing the stress corrosion properties.