Graduate Student Research Seminar

Fall 2021

Creep Behavior of Lightweight, Ti-based Multi-principal Element Alloy

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Monday, November 1st

3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

Multi-principal element alloys (MPEAs) are a classification of alloy that use multiple principal elements in equal or near equal parts, generally at least 5% atomic percentage for each element. Two newly discovered MPEAs are Ti60(AlCrNb)40 and Ti80(AlCrNb)20 which have shown promise to replace common lightweight, high strength alloys, such as Ti-6Al-4V, in applications such as aerospace and power generation. Ti-6Al-4V is the industry standard lightweight and high strength alloy, but it is known to have poor creep resistance, especially at extreme temperatures. Cavitations and voids are known to form along the α+β phase boundaries which significantly lessens creep resistance. The α phase HCP crystal structure is also known to be weak to dislocation climb. Additionally, Ti-based alloys are known to creep at ambient temperatures. Ti60(AlCrNb)40 and Ti80(AlCrNb)20 have potential to prevent these weaknesses through having a single β phase BCC crystal structure. To test this hypothesis, Ti60(AlCrNb)40 and Ti80(AlCrNb)20 will have their mechanical properties tested, at both ambient and elevated temperatures. Young's modulus, yield stress, and ultimate tensile stress will be measured for both alloys at ambient and elevated temperatures. The creep performance of Ti60(AlCrNb)40 and Ti80(AlCrNb)20 will be tested. Due to a lack of α phase and α+β phase boundaries, grain boundary sliding is expected to be a major contributor to overall deformation, so a grid based experimental technique is being developed to measure its impact. Different results are expected between Ti60(AlCrNb)40 and Ti80(AlCrNb)20 due to Ti60(AlCrNb)40 being classified as metastable and Ti80(AlCrNb)20 being classified as near-beta. The metastability of Ti60 could lead to precipitating phases that impact creep deformation.

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