Corrosion-Fatigue of Ti-6Al-4V Coupons Manufactured by Directed Energy Deposition

Daniel Hattingh[1], S. Botha[1], D. Bernard[1], Neil James[1], and Anton du Plessis[1]

[1]Nelson Mandela University

January 21, 2022

Abstract

Titanium is a versatile biocompatible metal that is desirable in additively manufactured medical implant devices. However, additively manufactured parts have particular microstructures, porosity, residual stress and surface conditions which can have a strong impact on fatigue performance. Implants have an added complexity from the saline operating environment and the associated impact on the safe design life. Equally, direct energy deposition induces a complex thermal history which, if not carefully controlled, can significantly alter the mechanical/material properties of the component. This study investigates the decrease in fatigue life, in an in-vitro body fluid simulation using Ringer's solution, observed in Ti-6Al-4V specimens extracted from coupons manufactured by directed energy deposition. An interrupted deposition strategy was employed to control build regularity, which appeared to influence certain mechanical properties, including corrosion fatigue life. An [?]50% decrease in fatigue life was observed in Ringer's solution at 6 Hz loading frequency, clearly important in designing implants.

Hosted file

`Article_ver 8 Final Review Rev 00 (002).docx` available at https://authorea.com/users/456585/articles/553583-corrosion-fatigue-of-ti-6al-4v-coupons-manufactured-by-directed-energy-deposition