Fatigue crack tip strain evolution and crack growth prediction under single overload in laser melting deposited Ti-6.5Al-3.5Mo-1.5Zr-0.3Si titanium alloy

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ABSTRACT

This paper focuses on the fatigue crack tip strain evolution in laser melting deposited Ti-6.5Al-3.5Mo-1.5Zr-0.3Si titanium alloy under constant amplitude loading plus single overload (OL). The digital image correlation (DIC) technique was used to capture and evaluate the crack tip strain fields and crack closure variation; the results showed that the strains near the crack tip become larger and the crack opening load increases after the application of the OL. The size of the retardation distance is consistent with the analysis results of the crack tip strain fields. The crack closure model based on the DIC analysis results can provide good predictions of the crack growth life for both the low and high overload ratios.

Keywords: Crack tip strain field; Overload; Fatigue crack growth; Laser melting deposition; Digital image correlation

1. Introduction

Titanium alloy has been widely used in modern industrial production because of its high strength, low density, good corrosion resistance, etc. [1,2] Because of its excellent comprehensive properties at room and elevated temperatures, Ti-6.5Al-3.5Mo-1.5Zr-0.3Si titanium alloy, which is a