M3-FATAM: *Multiscale fatigue modeling of additively manufactured Ti6Al4V alloys*

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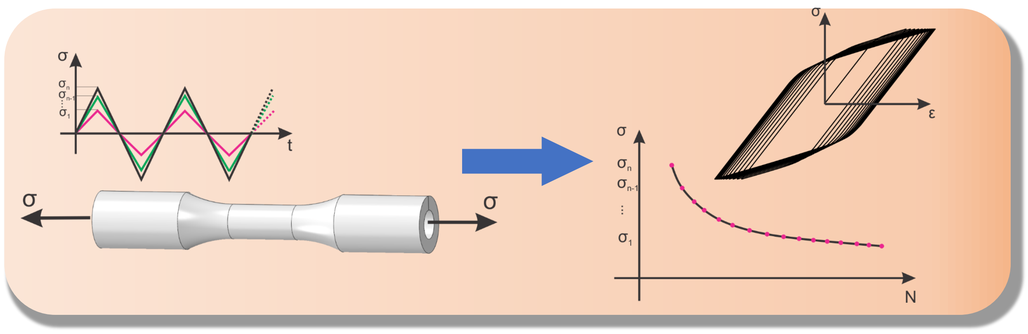
Introduction

High surface roughness and gas-entrapped pores are the culprits for inferior fatigue life of additively manufactured Ti6Al4V alloys. Thus, to precisely estimate the fatigue life of additively manufactured components, these features are incorporated into the proposed fatigue life model within the framework of the hierarchical multiscale method.

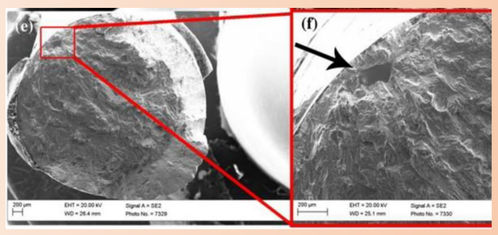
Methodology

Fatigue experimental testing on smooth, nearly homogeneous specimens

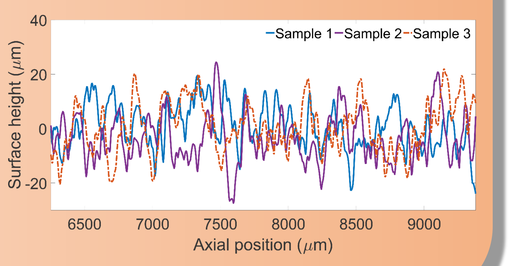


Defect characterization

Post-mortem fracture surface

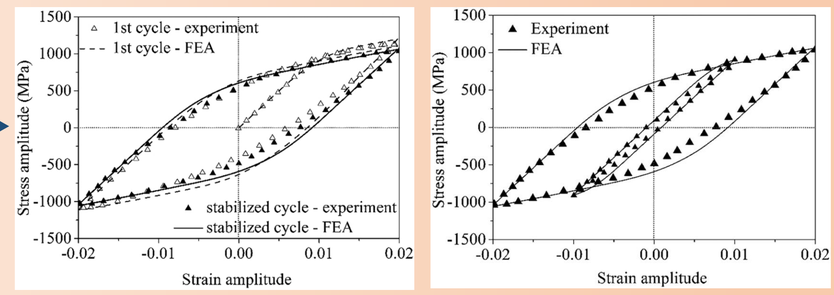


Surface roughness measurement

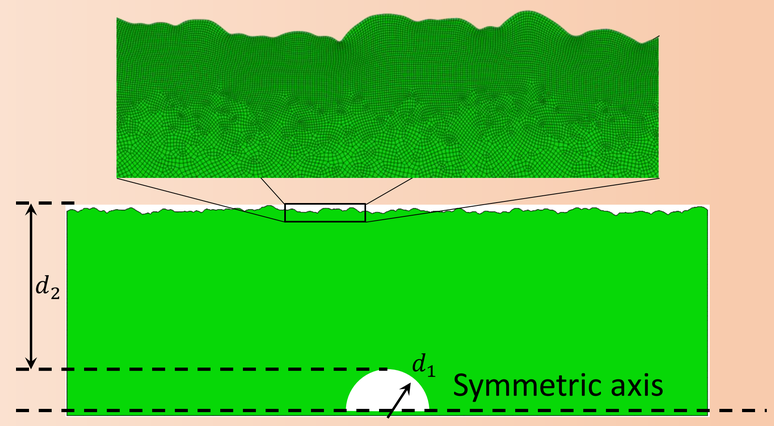


Material model

Finite element modelling

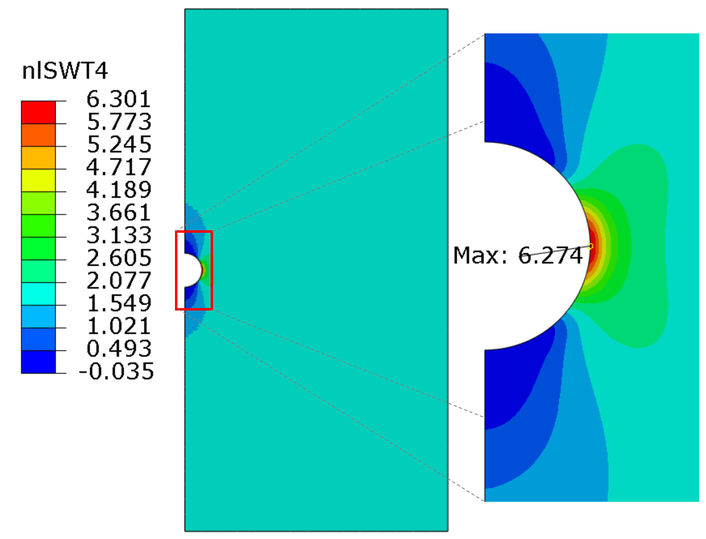


Geometrical model

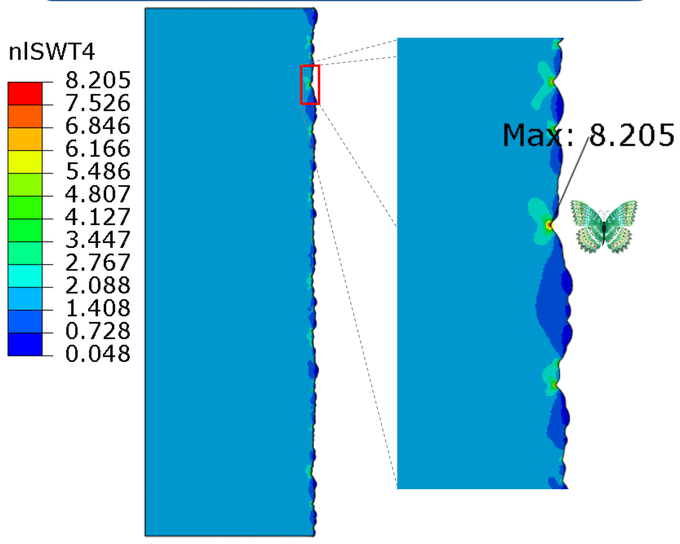


Results

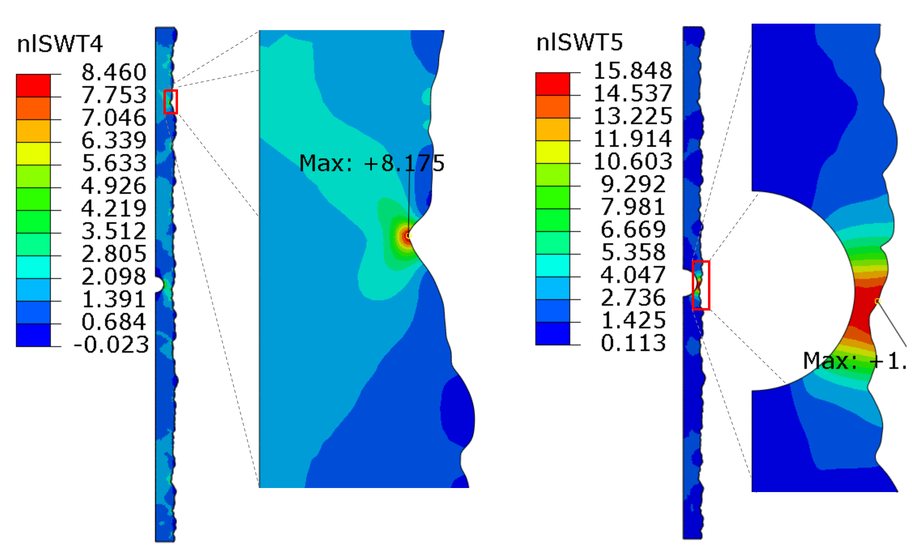
Subsurface pore failure mode



Surface failure mode



Competing failure modes



Conclusions

- Unified framework proposed to capture the effect of high surface roughness and gas-entrapped pores on the fatigue life of additively manufactured Ti6Al4V alloy
- Considering plastic deformation in calculation of the fatigue indicator parameter is indispensable

The authors gratefully acknowledge **SIM** (Strategic Initiative Materials in Flanders) and **VLAIO** (Flemish government agency Flanders Innovation & Entrepreneurship) for their support of the ICON project **M3-FATAM**, which is part of the research program **MacroModelMat (M3),** coordinated by Siemens (Siemens PLM software, Belgium)