Mechanical Behavior of Additively Manufactured Ti-5553 Octet Truss Lattices

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We used various characterization techniques to assess the response of additively manufactured Ti-5553 octet truss lattice structures under compressive load.

I. INTRODUCTION

Figure: The samples manufactured, their orientation on the build plate, and maybe their microstructure(?)

II. CHARACTERIZATION TECHNIQUES

A. High Energy X-ray Diffraction

1. Experimental Setup

Figure: The orientation of the sample in the room at APS

2. Stress and Strain Calculations

Equations: I.C. Noyan's theory on calculation of crystal stresses from measured strains.

B. Finite Element Modeling

C. Ex Situ Characterization

1. X-ray Computed Tomography

2. Microscopy and Fractography

III. RESULTS

A. Stress and Strain Measurements with HEXRD

Figure: A plot showing the sample and the stress/strain response at a few different locations around the sample.

B. FEA Model Without and With Residual Stresses

Figure: The X and Y strains calculated at maximum load and how they compare with/without residual stress applied.

C. Void Nucleation After Compression and Failure Mechanism

Figure: Show the CT images before and after compression, maybe show the distribution as well.

IV. DISCUSSION

A. Anisotropy in Stress Distribution Due to Residual Stress

Figure: Show the principal y strains at 200um load side-by-side with the principal y strains from the FEA model with residual stress applied.

B. Failure Occurring in Pure Stretch

Figure: Show the fractography results that Maria obtained.