IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	Multiscale Mechanics for Understanding Fatigue Behavior of 3D Printed Ti6Al4V Alloy	
Project Number	**IMURA0850**	
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Research Clusters:

Highlight which of the Academy's CLUSTERS this project will address? *(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*	
1	*Material Science/Engineering (including Nano, Metallurgy)*
2	*Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*
3	*Math, CFD, Modelling, Manufacturing*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*
5	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*
7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng*
8	*HSS, Design, Management*

Research Themes:

Highlight which of the Academy's Theme(s) this project will address? *(Feel free to nominate more than one. For more information, see www.iitbmonash.org)*	
1	*Advanced computational engineering, simulation and manufacture*
2	*Infrastructure Engineering*
3	*Clean Energy*
4	*Water*
5	*Nanotechnology*
6	*Biotechnology and Stem Cell Research*
7	*Humanities and social sciences*
8	Design

The research problem

Ti6Al4V is a commercially important alloy that has applications in aerospace and biomedical domains. 3D printed metals have inherent residual stresses due to directional microstructure evolution. Failure due to fatigue in Ti6Al4V is a complicated phenomena mediated by multiphase multiscale nature. For understanding the fatigue behaviour of 3D printed Ti6Al4V we study the interaction of residual stresses with co-deformation of dual phase microstructure of Ti6Al4V. This project will apply multiscale computational mechanics approach.

Project aims

1. Mechanical characterization of 3D printed Ti6Al4V.
2. Modeling of fatigue using multiscale modelling technique viz. molecular dynamics, phase-field, crystal plasticity.
3. Experimental investigation of effect of residual stress on fatigue behavior

Expected outcomes

1. Multiscale model of mechanical behaviour of 3D printed Ti6Al4V
2. Effect of residual stresses on fatigue life of 3D printed Ti6Al4V
3. Effect of 3D printing process on fatigue life.

How will the project address the Goals of the above Themes?

The objective of this project is to understand impact of residual stress on 3D printed Ti6Al4V. We intend to understand and model the effect of residual stress via combining the modelling and experimental efforts. This effort makes extensive use of concepts of plasticity and numerical methods.

Capabilities and Degrees Required

List the ideal set of capabilities:

1. Analytical skills
2. Willingness to learn and work hard
3. Crystal Plasticity or MD simulations or Phase Field Modeling
4. Computational Mechanics, Advanced Numerical Methods

A candidate with training in mechanical or materials engineering but with keen interest in learning computational mechanics and numerical methods.

Potential Collaborators

General Electric, ISRO, CSIRO, *Boeing, Hindustan Aeronautics Ltd. We have not contacted any yet.*

Select up to **(4)** keywords from the Academy's approved keyword list **(available at http://www.iitbmonash.org/becoming-a-research-supervisor/)** relating to this project to make it easier for the students to apply.

Modelling and Simulation, Metallurgy, Materials Chemistry/Science, Computational Fluid Dynamics and Mechanics