IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Combinatorial analysis of microstructure and micromechanical behavior of additively manufactured alloys**	
Project Number	**IMURA0887**	
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Research Clusters: **Research Themes:**

Highlight which of the Academy's CLUSTERS this project will address? *(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*		**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	*Material Science/Engineering (including Nano, Metallurgy)*	***1***	*Advanced computational engineering, simulation and manufacture*
		2	Infrastructure Engineering

The research problem

Define the problem

Additive manufacturing of metals has reached a level of maturity to be able to produce near net shaped products of complex shapes but there are several practical operational parameters that need to be optimised to obtain damage tolerant structures that perform as well as their wrought counterparts. This project will examine the particular challenge of controlling part variability in selective laser melting. Additive manufacturing can be modelled as a repeated welding process with extremely high scan speeds. Variables that determine the solidification kinetics and phase transformations such as scan speeds, heat input and post-processing parameters will finally impact their mechanical behavior. There is no control over the anisotropy that is in-built in into these microstructures. A comprehensive understanding of the physics and parameters of additive manufacturing/3D metal printing is still lacking. We will develop a combinatorial map of the effects of the processing parameters on the resultant microstructure and mechanical properties of single and dual phase titanium alloys using a combination of metallurgical process engineering and micromechanical testing.

Project aims

Define the aims of the project

To identify key process parameters controlling microstructure and texture evolution in additively manufactured Ti alloys using the design of experiments route and
To understand the micromechanical response of the complex morphologies developed during additive manufacturing using combinatorial mapping of additively architectured specimen.

Expected outcomes

Highlight the expected outcomes of the project

We anticipate that the project will advance the understanding of the manufacturing parameters that control part properties in additive manufacturing which can develop into new recommendations on optimisation schemes for selective laser melting of metallic alloys. Multi-scale micromechanics will provide fundamental insight on the behaviour of the textured interfaces across hierarchies typically encountered in additively manufactured alloys.

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

Describe how the project will address the goals of one or more of the 6 Themes listed above.

The additive manufacturing industry is still young, and one of the key drivers for uptake internationally is qualification of the manufactured parts. We cannot directly address industry capacity and uptake in this project, but this project will build capability that delivers high value add products that are competitive or better than conventionally manufactured parts. For example this research will make significant contributions that can be applied in the fields of biomedical implants and aerospace componentry. In particular it will contribute to the certification and qualification of components for aerospace and biomedical industries.

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

Essential

Degree in Materials Science; Metallurgical Engineering, or Materials Science and Engineering
Strong understanding of physical metallurgy, and solidification microstructures
Strong understanding of mechanical properties, including dislocation mechanisms

Desirable

Experience in mechanical testing
Experience in scanning electron microscopy
Experience in interpreting welding microstructures
Experience in finite element modeling

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

Select up to **(4)** keywords from the Academy's approved keyword list **(available at www.iitbmonash.org)** relating to this project to make it easier for the students to apply.