IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Laser Texturing of Titanium Alloys for Improved Wear Characteristics**	
Project Number	**IMURA0845**	
Monash Main Supervisor (Name, Email Id, Phone)	Aijun Huang, aijun.huang@monash.edu	*Full name, Email*
Monash Co-supervisor(s) (Name, Email Id, Phone)		
Monash Head of Dept/Centre (Name,Email)	Neil Cameron, neil.cameron@monash.edu	*Full name, email*
Monash Department:	Materials Science and Engineering	
Monash ADGR (Name,Email)	Jane Wilkinson, jane.wilkinson@monash.edu	*Full name, email*
IITB Main Supervisor (Name, Email Id, Phone)	Deepak Marla	*Full name, Email*
IITB Co-supervisor(s) (Name, Email Id, Phone)		*Full name, Email*
IITB Head of Dept (Name, Email, Phone)	Bhalachandra Puranik, head.me@iitb.ac.in	*Full name, email*
IITB Department:	Mechanical Engineering	

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

Define the problem

Titanium and its alloys have high strength and exceptional resistance to corrosion. However, the surfaces of titanium and that of all commercially produced titanium alloys have relatively poor wear resistance. Due to this, titanium surface in contact with any metallic surface would readily gall under conditions of sliding contact even with light loading or relatively little movement. Textures on titanium surfaces along with lubrication can drastically reduce the wear and increase the service life of the component. Therefore, the objective of this research is to improve wear characteristics of Ti6Al4V surface by fabricating textures on its surface using a high power pulsed laser. While there exists research related to texturing on titanium alloys, the work is largely restricted to experimental research and there is a lack of fundamental research. In order to generate superior surface characteristics with textures, gaining a deeper insight into the laser texturing process on Ti6Al4V about the evolution of residual stresses and microstructural changes would be very helpful. A multi-physics model of laser texturing process will be developed to gain a fundamental understanding of the process, which will be used to correlate laser parameters with experimentally measured residual stresses and microstructural changes. Lastly, the effect of various types of textures generated through this process will be studied to evaluate wear characteristics under sliding contact conditions.

Project aims

1. *To gain a fundamental understanding of laser texturing of Ti6Al4V process using multi-physics model.*
2. *To establish a correlation between laser parameters and surface characteristics using experiments.*
3. *To design novel textured surfaces with superior wear characteristics on Ti6Al4V.*

Expected outcomes

1. *Improve wear characteristics of Ti alloys for tribological applications.*
2. *Development of a novel themo-mechanical model of laser texturing of Ti6Al4V.*
3. *Development of novel textured surfaces for applications in tribology.*

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

1. *The research would lead to the development of a novel textured surfaces on Ti6Al4V for improving its wear characteristics. This could advance research in manufacturing.*
2. *The project would also advance fundamental understanding of laser-matter interaction with Ti6Al4V though development of novel multi-physics models to capture the phenomena of laser texturing.*

Capabilities and Degrees Required

Essential skills:
Strong background in material science, heat transfer, basic physics, mathematical modeling and computational methods
Computer programing in C/C++, Java or Fortran, MATLAB

Additional skills (not mandatory):
FEM, ABAQUS software

Qualifications:
B.Tech/M.tech in Mechanical Engineering, Materials Science and Engineering, Nanotechnology or Physics.

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.
1. Prof. Suhas Joshi (Metallurgical Engineering and Materials Science, IIT Bombay)
2. Prof. Xinhua Wu (Materials Science and Engineering, Monash University)

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.

Novel functional materials, computational fluid dynamics and mechanics, modelling and simulation