

An Indian-Australian research partnership

<b>Project Title:</b>	<b>Laser Annealing of Silicon Wafers for Solar Applications</b>	
<b>Project Number</b>	<b>IMURA0843</b>	
<b>Monash Main Supervisor</b> (Name, Email Id, Phone)	Jing Fu, jing.fu@monash.edu	<i>Full name, Email</i>
<b>Monash Co-supervisor(s)</b> (Name, Email Id, Phone)		
<b>Monash Head of Dept/Centre</b> (Name,Email)	Chris Davies, chris.davies@monash.edu	<i>Full name, email</i>
<b>Monash Department:</b>	Mechanical, Aerospace and Mechatronics Engineering	
<b>Monash ADGR</b> (Name,Email)	Jane Wilkinson, jane.wilkinson@monash.edu	<i>Full name, email</i>
<b>IITB Main Supervisor</b> (Name, Email Id, Phone)	Deepak Marla	<i>Full name, Email</i>
<b>IITB Co-supervisor(s)</b> (Name, Email Id, Phone)		<i>Full name, Email</i>
<b>IITB Head of Dept</b> (Name, Email, Phone)	Bhalachandra Puranik, head.me@iitb.ac.in	<i>Full name, email</i>
<b>IITB Department:</b>	Mechanical Engineering	

### Research Clusters:

### Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? <i>(Please nominate JUST <u>one</u>. For more information, see <a href="http://www.iitbmonash.org">www.iitbmonash.org</a>)</i>		Highlight which of the Academy's Theme(s) this project will address? <i>(Feel free to nominate more than one. For more information, see <a href="http://www.iitbmonash.org">www.iitbmonash.org</a>)</i>	
1	Material Science/Engineering (including Nano, Metallurgy)	1	Advanced computational engineering, simulation and manufacture
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	Infrastructure Engineering
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	4	Water
5	Earth Sciences and Civil Engineering (Geo, Water, Climate)	5	Nanotechnology
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Biotechnology and Stem Cell Research
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng	7	Humanities and social sciences
8	HSS, Design, Management	8	Design

## The research problem

### *Define the problem*

Ultrathin Silicon wafers of 120-150 micrometers thickness can be fabricated using wire-electrical discharge machining (WEDM) process. While the wafer thickness is considerably smaller than those obtained using conventional techniques, the process has inherent disadvantages, which include white layer formation and high residual stresses. The presence of these defects on Silicon wafer makes it ineffective for applications in solar cells. Laser annealing is a potential technique to completely remove the white layer and also minimize residual stresses. In this project, we explore laser annealing as a process to enhance surface characteristics of the ultrathin silicon wafers cut using WEDM. The project would first involve characterizing the white layer and the residuals stresses in the processed silicon samples and thereafter derive the optimal processing conditions for laser annealing using a synergistic computational and experimental research. The computational work would involve developing a coupled thermo-mechanical multi-physics model to predict the temperature and residual stresses during the process.

## Project aims

1. To eliminate white layer and minimize residual stresses on Silicon wafer samples using laser annealing
2. To characterize white layer and residual stresses on Silicon wafer samples obtained using WEDM process.
3. To develop a multi-physics model of laser annealing process for Silicon

## Expected outcomes

1. Improving the surface characteristics of Silicon wafers for enhancing solar cell performance
2. Enhance the understanding of laser annealing of Silicon through a computational multi-physics model

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

1. The research would lead to fabrication of Silicon wafers with improved efficiency, which has a great application in solar energy sector, contributing towards clean energy.
2. A coupled thermomechanical multiphysics model of laser annealing of Silicon would be developed as a part of this work, which could significantly contribute towards advancing computational research in manufacturing.

## Capabilities and Degrees Required

### *Essential skills:*

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

### *Additional skills (not mandatory):*

Finite element methods, 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](http://www.iitb.ac.in) OR Monash Website [www.monash.edu](http://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. Ramesh Singh (Metallurgical Engineering and Materials Science, IIT Bombay)
2. Prof. Aijun Huang (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.

Energy materials, computational fluid dynamics and mechanics, Materials science, Modeling and Simulation