IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Laser Annealing of Silicon Wafers for Solar Applications**	
Project Number	**IMURA0843**	
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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

Define the problem

Ultrathin Silicon wafers of 120-150 micrometers thickness can be fabricated using wire-electrical discharge machining (WEDM) process. While the waver 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 programing 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 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. 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