

An Indian-Australian research partnership

Project Title:	Understanding the mechanical behavior of Al-Ti nanolayered metal composites	
Project Number	IMURA0685	
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Research Academy 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

The research problem

Nanolayered metal composites (NMC) demonstrate exceptionally high strength due to nanoscale layer thicknesses of layers. A number of researchers have demonstrated that these NMCs can be developed in bulk by severe plastic deformation by using accumulative roll bonding process (ARB). These nanocomposites offer possibility of unique combination of high strength and toughness that may sometimes be not only challenging but also economically unfeasible. NMCs are intended to replace current high performance alloys such as superalloys, steels and coatings such as hard chrome. This project aims at understanding the mechanical behaviour of Al-Ti NMC for various layer thicknesses. The

evolving strength of Al-Ti NMC will be analysed as a function of layer thickness. Microstructure will be analyzed by using EBSD and TEM at critical intermediate stages for establishing structure-property relation. In addition, a crystal plasticity model (Alankar et al. 2009, 2011) will be used for understanding the deformation mechanisms in Al and Ti and in the Al-Ti NMC.

Project aims

1. Mechanical and microstructure characterization of pure Al and Ti at room temperature at various degrees of plane strain compression
2. Mechanical and microstructure characterization of Al-Ti nanolayered composite at various stages of deformation.
3. Analysis of 1 and 2 by using a CPFEM model

Expected outcomes

1. Mechanical and microstructure characterization of Al-Ti NMC as a function of strain
2. Understanding role of Al-Ti interface on strengthening. This will be achieved via exploring dislocation-interface interaction.

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

The objective of this project is to develop a multilayered metal nanocomposite and analysing the mechanical behaviour by using a crystal plasticity mode. Thus, the project falls under two categories viz. (1) Advanced computational engineering, simulation and manufacture and (2) nanotechnology.

Capabilities and Degrees Required

List the ideal set of capabilities:

1. Analytical skills
2. Willingness to learn and work hard

Potential Collaborators

Prof. Jian-Feng Nie

Please provide a few key words relating to this project to make it easier for the students to apply.

Modelling, crystal plasticity, theory of dislocations, nanolayered materials, nanocomposites, nanotechnology, finite element analysis, plastic deformation