

An Indian-Australian research partnership

Project Title: Study of nano-structured interphases to understand structure-property correlation using chemical microscopy

Project Number IMURA0406

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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

The research problem

Define the problem

- Identify and select polymer based systems e.g. polyolefins
- EELS/EFTEM studies
- Validate using other spectroscopic and chemical studies :FTIR, Raman, Mw, MWD, GPC

Project aims

Define the aims of the project

Expected outcomes

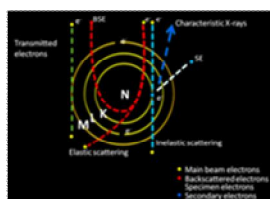
Highlight the expected outcomes of the project

- Establish the EELS/EFTEM as tool for polymeric materials: blends/films/composites
- In the long run, gain fundamental understanding on the structure property correlation for SABIC grades

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.

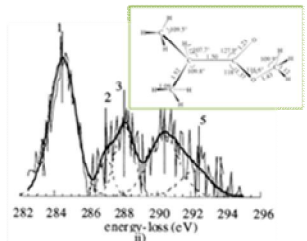
BACKGROUND: UNDERSTANDING OF EELS



Inelastic scattering: Band structure & elemental info

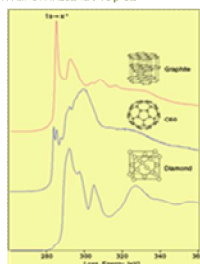
Property determined	Spectral region	Processing required	Uses
Sample thickness	low loss region	Integration of intensities	measure of relative thickness
Valence electron density	low loss - plasmon peak	peak fitting	phase identification/allotropy
Elemental conc and distribution	high loss-ionization edge	background subtraction	relevant for light elements
Chemical characterization	high or low loss	EFTEM	chemical structure
spatial image with chemical composition	low loss	EFTEM	detect & chemical bonding

Structural elucidation of PMMA

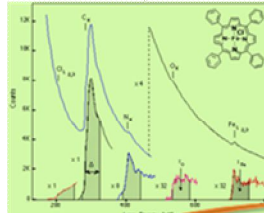


K. Verbit et al / Polymer 40 (1999) 5681-5687

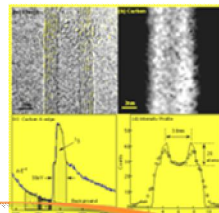
Differentiate isotopes



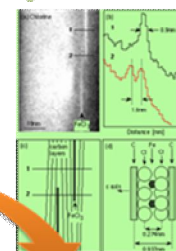
Elemental Analysis



Quantification of Elemental Mapping



High resolution Elemental Mapping



EELS gives spatially resolved chemical understanding

- Catalyst deactivation
- Blend Compatibilization
- Exposure/Weathering performance
- Heat aging

Courtesy: <https://www.linl.gov/str/September05/shih.html>

Schematic Representation

Gaps: relating bulk property changes with mol. Level changes and color moieties as seen during exposure studies
Business relevance -degradation studies

Schematic Representation

Gaps: fundamental understanding of adhesion failure in coatings, through chemical understanding
Business relevance -Hard-coat, multilayer packing

(a) Compatibilizer
 (b) Base resins
 (c) Compatibilised blend

Gaps: fundamental understanding of diffusion and interpenetration during compatibilization and relating it to the chemistry
Business relevance -blend compatibilization studies

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.

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.