CSIRO MATERIALS SCIENCE AND ENGINEERING

Foundation

- 1926 (CSIRO established)

Employees

- ~ 70 effective full time research staff, inclusive of PhD students and post-doctoral fellows co-supervised with Australian universities.

Key materials

- Bio-derived monomers and polymers
- Natural polymers and biodegradable polymers
- Natural fibres and biocomposites

Key R&D/services

- Development of bio-derived chemicals through biorefinery (thermochemical, biocatalytic and chemical) processes
- Modification and thermal process of natural polymers
- Development of new applications for biodegradable polymers, natural fibres and biocomposites
- Structure/property and performance relationships in sustainable materials
- Accredited testing of compostability of materials

Sustainable High Performance Materials

CSIRO (Commonwealth Scientific and Industrial Research Organisation) is Australia's national science agency and one of the most diverse scientific research organisations in the world. CSIRO employs some 6000 staff and has an annual budget in excess of $1.3 billion. CSIRO Materials Science and Engineering is the largest of 11 divisions and hosts a range of scientific capabilities, which enables us to combine the scientific disciplines of biology, chemistry and physics with electrical, mechanical and software engineering to provide advanced materials based technologies.

Our R&D in the area of sustainable high performance materials seeks to develop technologies that maximise the value, performance and safety of advanced materials while minimising negative environmental impacts through their life-cycle. We have a particular focus on the development of bio-derived and biodegradable polymer materials and composites. We are your competent partner in all phases of material synthesis and modification, processing scale-up and application in the development of bio-based polymers and composites.

Core Capabilities in the area of Bio-based Materials and Composites

- Biorefinery processing of woody biomass, algae, grasses and crop wastes via thermochemical, biocatalytic and chemical conversion/ purification processes to obtain renewable chemicals on scales from laboratory to hundreds of kg/L.
- Development of biodegradable materials from natural polymers (starch, proteins, cellulose, natural resins, plant oils, etc.), synthetic polymers (PLA, PCL, PBSA, etc.) or CO_2-based polymers (PPC) through chemical modification and thermal processing (reactive extrusion, thermal forming, injection moulding, foaming and powder processing)
- Processing of bast fibres, cotton and protein fibres into woven, knitted and nonwoven constructions at lab and pilot scale. Fibre surface modification including chemical and plasma processing. Incorporation of fibres and textiles into novel composite structures.
- Morphology and interface design for biocomposites and biocomposite manufacturing.
- Application development of biodegradable polymers and biocomposites
- Biodegradation mechanism (including microbiology) studies and compostability testing

We also have significant research capabilities in other areas such as: functional surface modification and coatings, high performance resin development and composite fabrication, molecular modelling and property prediction of network polymers, self healing composites and adhesives, light weight, multifunctional protective materials, and nano-additives design, synthesis and dispersion.

Recent Achievements in Bio-based Plastics and Composites:

- Biocomposite shipping pallets as an alternative to hard wood timber pallets
- Biodegradable polylactic acid foaming technologies
- Starch-based biodegradable food packaging products
- Wheat gluten-based coatings for recycled paperboards for humidity resistance
- Powder processing of cellulose-based bio-waste into renewable and biodegradable bulk plastics

Key Facilities

- Polymer Processing and Characterisation Facilities: including a series of reactive extruders from lab research desk-top machines to industrial scales, specific catalytic screw elements, co-extrusion (fibre, films, tubing), injection molding, compression molding, resin transfer moulding, batch mixers, various ovens and specialised polymer and composites characterization equipment (thermal analysis, chromatography, rheology and mechanical properties)
- Biorefinery facilities: bio-reactors on scales from lab research to industrial scale-up, stills, pyrolysis units, biocatalysis and large scale chemical conversion/purification facilities.
- Large-scale fibre, textile processing and testing facilities: fibre extrusion pilot plant, short staple and worsted ring spinning plants, capability to process any fibre and/or filament through to woven, knitted or nonwoven structures. National Association of Testing Authorities (NATA) accredited fibre and textile testing facilities for development and assessment of a wide range of new fibre and textile products.
- Biodegradation Facilities: NATA accredited facilities to test the compostability of materials, including biodegradation testing in aerobic compost, disintegration testing in a pilot scale composting bin, higher plant ecotoxicity testing and earthworm ecotoxicity testing.
- Surface Engineering and Electrostatic Powder Coating Facilities: robotically incorporating multifunctional interphases or surfaces of products, electrical charge transfer combined with adhesion promotion and biocompatibility (lab & process scale-up)

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