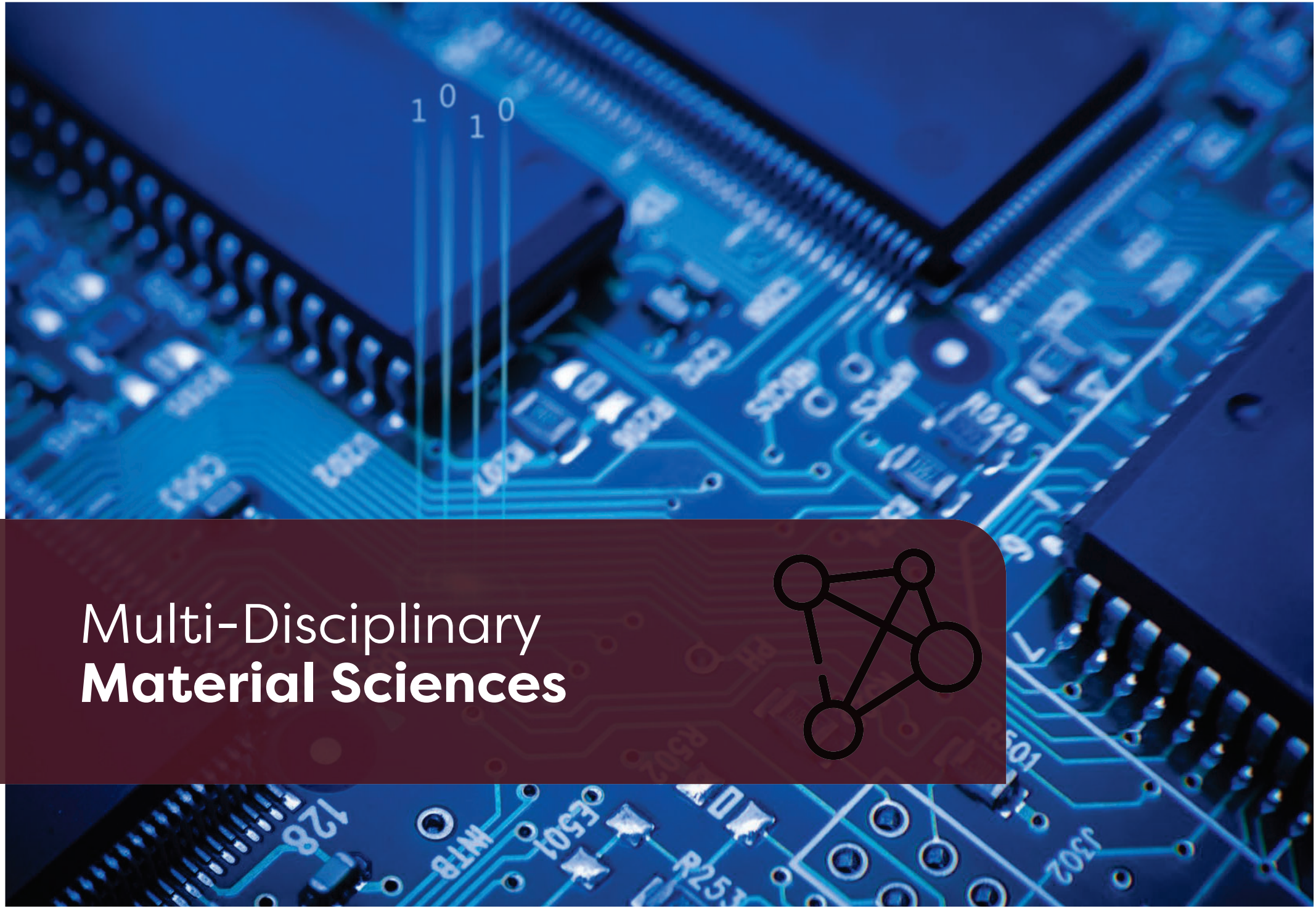

Multi-Disciplinary
Material Sciences

Advances in materials technologies on the critical path to the delivery of many new and potentially disruptive Defence capabilities. Exploring materials and processes that support advanced manufacturing.

UWA is at the forefront of international research, leading renowned university labs and research labs of major aerospace & defence industry players, including military/government contractors. Our expertise includes advanced optoelectronic and microelectromechanical sensor technologies and fabrication of infrared and x-ray/gamma-ray detectors.

DEFENCE RESEARCH CAPABILITY CATEGORY: **MULTI-DISCIPLINARY MATERIAL SCIENCES**

UWA Competitive Advantage

- Expertise in infrared (IR) materials and detector technologies, and microelectromechanical systems (MEMS) providing optical MEMS-based infrared sensing technologies for spectroscopy and/or imaging.
- Functional materials (intelligent or smart metals), specifically shape memory alloys and magnetoelastic materials. These materials are lightweight, solid-state alternatives to conventional actuators such as hydraulic, pneumatic, and motor-based systems.
- Granular materials and fracture formation.
- Ultrafine and nano powders, nanomaterials and nanostructured ceramics.
- Polymers, geopolymers, ceramics and composites.
- Explosives.
- New impact-resistant carbon fibre composites, composite–metal adhesive bonding, and composite repairs.
- Optics, photonics, microwave electronics and communication systems.
- Alloy development for 3D printing of metals using selective laser melting, resulting in superior material properties.
- Sensor development and fabrication expertise includes sensors of both fundamental and complex parameters, using new materials, sensor readouts and data analysis and networking sensors into intelligent arrays. Sensor development spans a wide range of modalities;
  - » electromagnetic (infrared (NIR, SWIR, MWIR and LWIR), hyperspectral, terahertz band, magnetic biosensing, optical/fibre optical systems, detecting weak electrical signals in littoral and estuarine waterways, low-noise sapphire microwave oscillators.
  - » Gravitational.
  - » Single-chip gas, chemical, pressure and temperature sensors.

  - » Advanced microelectronic, optoelectronic and photonic materials, devices and systems
  - » Developing low to zero power sensor systems, leveraging energy harvesting to power remote sensors connected through a low power radio network.
  - » Investigating nano-porous silicon for MEMS-based sensors and technology for long-wave thermal imaging applications.
- Developing a software platform to analyse and visualise the unique 3D terahertz datasets produced in partnership with terahertz hardware manufacturers and application developers. Terahertz frequencies provide structural information and can image through plastic, paper and fabric, with applications in defence and security such as detecting concealed weapons or hazardous substances through clothing and packaging.
- Electromagnetic interference shielding composites using 3D printing

Outcomes and Impact

- Non-woven Kevlar fibre veils for interfacial toughening and electrochemical corrosion resistance, and resin pre-coating for composite repair and stronger adhesive bonding with metals.
- More efficient, less expensive and more adaptable lubricants, heat transfer fluids, solvents for electrodeposition, and electrolytes in batteries and capacitors, suitable for environmentally harsh conditions (eg, aeronautical, space, and mining industries).
- Low cost sensing technologies designed for real-world applications with foci including the environment, infrastructure monitoring and airborne remote sensing.
- Intelligent processing of sensor data and data reduction techniques.
- A new class of sensors operating in the IR part of the spectrum that provide unique multi-spectral sensing capabilities with reduced size, weight and power requirements. Applications in multi-spectral imaging, night vision, and standoff spectroscopy sensors, with a strong focus on intelligence, surveillance and reconnaissance (ISR) applications in defence and security.
- Modelling to support optical system evaluation, and radar cross-sectional studies using finite-difference time-domain (FDTD) models, in collaboration with the Submarine Optronics Group within DSTG.
- First in the world to demonstrate the ability to 3D print amorphous parts of any size, superconducting components, and low-modulus beta-titanium alloys. Developing new high strength-to-weight structures and measuring the strain rate properties of 3D printed solid and porous structures for impact/blast protection applications.
- Electromagnetic interference shielding composites using 3D printing: This research investigated the development and evaluation innovative methods for the use of conductive cementitious composites as an electromagnetic interference shield in the 3D printing concept. New testing methods have been developed to determine the best conductive components to use in the design of cementitious composites for shielding and 3D printing that shows the best promise. The conductive cementitious composites have the potential to provide electromagnetic shielding that is cost-effective in terms of construction, operation, and maintenance compared to conventional approaches.

Capabilities and facilities

- The WA node of the Australian National Fabrication Facility (ANFF) at UWA provides state-of-the-art facilities and expertise in IR technology and MEMS systems design and advanced fabrication and manufacturing capabilities for industry and broader research communities. These capabilities are in high demand and unique in Australia.
- The Microelectronics Research Group runs a completely vertically-integrated facility, from materials growth, through device design, fabrication and testing, to packaging and sub-system assembly. In collaboration with other world-leading organisations, it is also actively involved in the development of new and emerging semiconductor materials including mercury cadmium telluride (next generation IR detectors) and Group-III nitride technologies (high performance electronics and UV detectors).

Contact Details

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