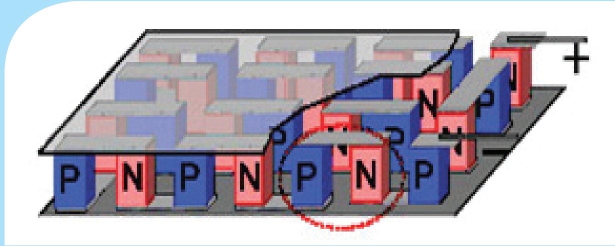
Innovative materials for energy conservation and environmental benefit

The Institute for Superconducting and Electronic Materials (ISEM) is a world-class cooperative research team examining the fields of energy, superconductivity and electronic material science and technology.

Led by Professor Shi Xue Dou, an internationally renowned expert in the fields of energy storage and superconductivity, ISEM has been instrumental in advancing these technologies in Australia and the world.

ISEM has a team of more than 100 researchers and postgraduate students with a track record of research breakthroughs that are helping to redefine the applications of electronic materials science.



Innovative materials for energy conservation devices

Innovative materials developed have unique properties of magnetocaloric effect that can be used to design and construct new refrigerators and thermoelectric properties that can be used to design and build devices to convert the waste heat to electricity in many plants and automobiles. These research programs are focussed on turning research success into the devices and materials that will improve energy efficiency and promote environmental protection.

The state-of-the-art facilities at the Australian Institute for Innovative Materials (AIIM) will allow breakthrough lab-based experiments to be transformed into commercial reality by developing the new processes and devices needed to scale-up laboratory breakthroughs.

Contact us for more information

For more information on ISEM's innovative materials research program and commercial opportunities contact Professor Shi Xue Dou on +61 2 4221 5730 or via email at shi@uow.edu.au or visit ISEM's website at www.isem.uow.edu.au

INSTITUTE FOR SUPERCONDUCTING AND ELECTRONIC MATERIALS

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Projects in innovative materials research being undertaken at ISEM include:

Project	Thermoelectric generator development for waste heat recovery
Aims	To develop thermoelectric generators for long term extensive application at high temperature for waste heat harvesting in industrial plants.
Background	More than half of the primary energy consumed in the world is lost as heat and therefore, even recovery of a small fraction would have a substantial impact on global energy consumption. The Energy Conservation Group at ISEM, in collaboration with industry partner BaoSteel Company, is undertaking a project to develop thermoelectric generators for waste heat recovery from steelworks. Efforts will be made to: ▪ Explore advanced bulk thermoelectric materials with high figure of merit at temperatures over 800 K ▪ Develop thermoelectric modules for thermoelectric generators ▪ Design efficient heat exchangers for transferring heat sources to thermoelectric generator ▪ Design, fabricate, and assemble prototype thermoelectric generators and assess their performance ▪ Verify the device and system performance under operating conditions
Techniques	Innovative approaches to electronic distortion; band engineering, phonon scattering and fabrication techniques will be investigated to achieve thermoelectric materials with high figure of merit. Prototype thermoelectric modules will be assembled via exploring thermal interface materials, studying the fabrication techniques and improving the electrical and thermal contacts. Prototype thermoelectric generators will be constructed and their durability will be evaluated.

Project	Innovative Magnetocaloric Technologies for Room Temperature Refrigeration
Aims	To develop novel giant magnetocaloric (GMCE) materials with the intention to fulfill the demands of future commercial magnetic refrigeration systems operation at room temperature.
Background	Magnetic refrigeration (MR) is an innovative, environmentally friendly, cost effective technology with an energy saving of up to 30 per cent compared to the conventional as compression refrigeration, is based on the magnetocaloric effect (MCE). The MCE is intrinsic to all magnetic materials, indicates that the paramagnetic or soft ferromagnetic materials expel heat and their magnetic entropy decrease when the magnetic field is applied isothermally; or otherwise absorb heat and their magnetic entropy increases when the magnetic field is reduced isothermally. MCE reaches a peak in the vicinity of the magnetic ordering or Curie temperature. Series of prototype giant MCE materials are being developed at ISEM. The project merges the expertise on magnetic materials at ISEM. The expected outcomes will be an understanding of GMCE mechanism and developing of bulk and nanostructureed GMCE materials, and demonstration of prototype MR devices.
Techniques	Serials of oxides, alloys and nanostructured GMCE materials will be continuously produced, evaluated and optimised for maxima the efficiency of MR. A prototype of MR device will be designed, assembled and demonstrated for evaluating the MR efficiency of developed GMCE materials at ISEM.