Advanced materials for better medical technologies

The Institute for Superconducting and Electronic Materials (ISEM) is a world-class cooperative research team working on 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 advanced materials, ISEM has been instrumental in advancing these technologies in Australia.

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 advanced materials science.

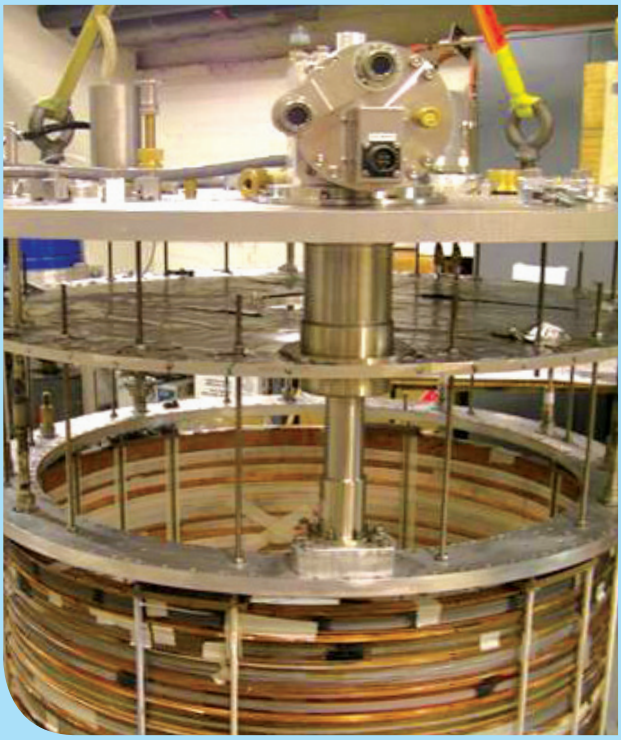
Innovative materials for novel devices

Innovative new materials developed using thin film technologies can be applied in new and innovative ways to help create non-invasive medical diagnostic tools such as wearable pulsimeters that can measure blood pressure and heart rate quickly and easily.

Image courtesy of collaborators at Sangji University, Korea

Superconducting technology can also be used in the next generation of magnetic resonance imaging (MRI) machines.

ISEM's teams are working on innovative materials that have applications in medical devices, biomedical applications and telecommunications technologies.



From research success to commercial success

ISEM's research programs are focussed on turning research success into the devices and materials that will change the way we go about our daily activities.

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.

Contact us for more information

For more information on ISEM's advanced materials research 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

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Projects in advanced materials research for medical applications being undertaken at ISEM include:

Project	New MRI design using Magnesium Diboride superconducting coils
Aims	An alternative superconductor for Magnetic Resonance Imaging (MRI).
Description	MRI is a powerful diagnostic tool to visualise soft tissue and the superconducting magnet is the most expensive component of the system. ISEM has had a leading role in developing of commercially available inexpensive magnesium diboride wire in close collaboration with its industry partner, Hyper Tech Research Inc (HTR). Through optimisation and nano-doping ISEM has acquired patented technology for fabrication of MgB2 wire with record performance in critical current in magnetic field, satisfactory to commercial exploitation. HTR is capable of manufacture of multi-kilometre long wire with high reproducibility.

Project	Development of oriental medical pulsimeter using magnetic field sensing thin films
Aims	This project will develop a non-invasive medical pulsimeter to increase the reliability of the sensors, improve the ease of operation and reduce the cost of production.
Description	The pulsimeter sensor will use magnetic field sensing thin films with the pulse-sensing part array consisting of Giant Magneto Resistance-Spin Valve or Hall Effect Semiconductor devices that will detect changes in the magnetic field on contact with the skin, allowing the pulse to be measured through the detection of changes in the magnetic field.

Project	Advanced nano-ceramics for protective, diagnostic and therapeutic uses
Aims	These projects are aimed and the development of new materials for nano-theranostic use, radiation protection and UV blockers for sun protection.
Description	New ceramic-based materials are being developed include: ▪ Inorganic UV blockers to more efficiently and effective reduce UV expose across the entire UV range ▪ Metal oxides or carbon-based materials to deliver muntifunctionality and improved therapeutic and diagnostic nano-composites at a lower cost Researchers at ISEM are working collaboratively with the Illawarra Health and Medical Research Institute and the Centre for Medical Radiation Physics to develop ceramic composites for use in cancer therapy and to develop radiation protection drugs. Testing has shown a reduction of up to 50 per cent in cancer cell survival rates after 72 hours using these technologies. This is a substantial improvement on most chemotherapy drugs which typically reduce cell survival rates by 14 per cent over the same period.

Project	Novel multifunctional magnetic nano-composites for cancer diagnosis and hyperthermia therapies
Aims	To develop and study novel multifunctional magnetic nano-composite particles combining the improvements of the medical sensing of cancer MRI diagnosis and the efficiency of cancer magnetic hyperthermia therapies.
Description	Magnetic nanoparticles have been advocated for use in magnetic resonance image (MRI) enhancement and as bio-carriers in biological systems. However, it is only in recent years that the fields of nanotechnology, materials science, and cell biology have combined to enable us to fully comprehend the potential uses of such nanoparticles for more biomedical applications, such as magnetic fluid cancer hyperthermia (MFH). Researchers at ISEM have developed effective nanostructured materials production techniques that will allow a better understanding of methods to improve the efficacy of magnetic cancer diagnosis and therapies.