



Bio21 Molecular Science and
Biotechnology Institute

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Small is Powerful

With its interests and specialist expertise in research at the interface of biology, materials science and nano-engineering, the Bio21 Institute is well positioned to contribute in the rapidly emerging field of nano-biotechnology. Major opportunities are in the development of functional polymers based on fibre-forming peptides (eg amyloid), nano-particle-based therapeutics and medical, agricultural and environmental biosensor devices linked with miniaturized detectors and wireless data transmission systems.

The considerable potential for industry innovation, based on the miniaturization and convergence of bio- and nano-technologies is reflected in the recent escalation of investments by governments in the field globally, in partnership with industry and universities.

With its capabilities and specialist expertise in research at the interface of biology, materials science and nano-engineering, the Bio21 Institute is well positioned to contribute in this emerging area. Further opportunities are being pursued through a number of collaborations/alliances with local and international researchers in strategically important areas of nano-biotechnology.

The core of the Bio21 Institute's small technology capability is based on the collective expertise of resident and associate chemists, engineers, computer scientists, protein chemists, cell biologists and dental scientists.

A critical mass of researchers with complementary expertise in nano materials science is rapidly developing within the Institute, which includes two Federation Fellows (Andrew Holmes and Paul Mulvaney), an ANSTO Fellow (Daniel Riley), a recently recruited QEII Fellow (Glen Burley) and recently appointed Biomolecular and Chemical Engineer (Sally Gras).

Importantly, the Institute's nano-biotechnology programs are linked strategically with the University's recently established Centre for Nano Science and Technology led

by Federation Fellow, Frank Caruso. Equally important are the Institute's specialist expertise in cultured cells and small animal systems, access to the Veterinary Science School's large animal models (sheep and pigs) and links with the Bio21 Cluster's pre-clinical and clinical development groups, which all provide unique resources for testing prototype devices.

A key enabling development has been the recent establishment of the Institute's Nanotechnology and Microscopy Centre, incorporating high resolution electron microscopy with advanced capabilities in imaging, microanalysis and nano-fabrication, as well as an associated clean room.

The \$10 million facility, commissioned in September 2006, has been jointly funded by the University of Melbourne and the State Government (\$1 million towards the construction of the clean room). The Institute's electron microscopy and microanalysis capability is to be further developed with the recent award of National Research Infrastructure Scheme funding from the Commonwealth Government (NCRIS).

The facility is equipped with essential laboratory infrastructure for general sample preparation, chemical assembly of nano structures and the preparation of clean proteins for incorporation into drug delivery and biosensor devices for pre-clinical testing.

The new facility has state-of-the-art cryo-EM and related instruments for molecular imaging of the structures of chemically assembled materials, large protein complexes and the distribution of functional components within cells. Other instruments include environmental SEM and field emission gun (FEG)-based transmission electron microscopy and confocal microscopy. Focused ion beam scanning EM and Atomic Force Field Microscopy (AFM) for a broad range of physical sciences, life sciences and engineering applications.

Examples of small technology applications targeted for development within the Institute's Nanotechnology and Microscopy Centre include:

- Nano-thin-film-based drug delivery capsules
- Nucleic acid-based voltaic devices with potential as biosensors
- Biocompatible tissue regeneration scaffolds and other implants for tissue engineering applications
- Functional scaffolds based on fibre forming (amyloid) peptides incorporating bioactive materials (eg tissue growth factors)
- Protein chip arrays for high through put investigation of protein – protein interactions and their inhibitors,

as well as functional proteomics and protein-bound metabolomics investigations

- Biosensors for use in pre-clinical development and environmental monitoring based on protein reporters linked with quantum dots and photoelectronic detector and wireless data transmission systems
- Phosphopeptide-based nano-mineral delivery systems for tooth repair, a novel technology which is being developed by Eric Reynolds' group and is currently undergoing testing in various in-vitro models and preliminary clinical trials
- Light-emitting polymers of a type similar to the polymers previously developed for electronic flat screen and solar cell applications, will be investigated for potential use in biosensors.

As with all other Institute technology platforms, provisions have been made for external user access, including industry and visitors' laboratory facilities for sample preparation. The Institute's capacity to support external scientists from both academia and industry is further increased following the investment of NCRIS funds in new microscopy equipment and specialist technical staff.

