Bachelor of Science in:
Nanotechnology

NANOTECH AT CURTIN

scieng.curtin.edu.au
About: Nanotechnology

There’s Plenty of Room at the Bottom

The origins of nanotechnology can be traced back to December 1959, when Nobel Laureate Richard Feynman presented a talk titled “There’s Plenty of Room at the Bottom” in which he argued for scientific development at the molecular and atomic level, stating, “a point that is most important is that it would have an enormous number of technical applications.” As an example of nanoscale information storage, Feynman postulated a means by which “all of the information that man has carefully accumulated in all the books in the world can be written… in a cube of material one two-hundredth of an inch wide—which is the thinnest piece of dust that can be made out by the human eye.” In 1974 Norio Taniguchi defined nanotechnology for the first time, but it was not until 1981, when IBM invented the scanning tunnelling microscope, that scientists could examine materials on a nanometer scale. In 2003 it was predicted that “Nanotechnology… is the future of manufacturing, and it will redefine the landscape of high technology.” The race to the ‘bottom’ has already begun.

Graduate Profiles

Andrew No

Andrew graduated in 2006 and has moved to Singapore where he is working as a research assistant at the Institute for Materials Research and Engineering. He is part of a research team developing transparent, flexible conductive materials using carbon nanotubes as the conducting medium.

I applied for the job I wanted in Singapore and three weeks later I was walking into the research building on staff. The units in the course equipped me well for the type of work I am currently doing, especially my honours year.

Jun Chai

Jun was the very first student to complete Curtin’s BSc (Nanotechnology) degree, graduating with 2A Honours in 2005. She is now working as a research assistant in the Research and Development team at Advanced Nanotechnology Ltd. – a local manufacturer of nanoparticles for a range of applications including transparent zinc oxide sunscreens and polishing powders. "The Nanotechnology degree suited me best because I’ve always loved science and mathematics. I enjoyed learning about the natural world. It is the latest technology now. There is endless opportunity to explore and discover in this field.

Undergraduate Courses: Bachelor of Science (4 years) Nanotechnology

Where Will You Work?

Graduates of the Nanotech program can be employed as physicists or chemists due to their strong skills in those areas. However, many are employed in industries and roles related to research and development, materials science and commercialisation. Some examples include:

- Major international companies with significant R&D activities in nanotech include Philips, Siemens, Bayer, Roche-Paulex, Air Liquids, Dow Chemical, Mobil, Hewlett Packard, IBM, Chevon, Dupont, Fuji, Hitachi, Mitsubishi, NEC. Sony and many others, including companies such as the French cosmetics giant L’Oreal.
- Nanomaterials are already in use in advanced ceramics, paints and pigments, medical implants, filters and additives, anti-corrosives, adhesives, UV absorbers in sunscreens, targeted drug delivery, scratch resistant coatings for car windshields and catalysts for industrial processes.
- Using a nano-thin layer, Pilkington have created the first self cleaning glass, Pilkington Acts™. The glass surface reacts with UV light breaking down dirt particles which are washed away by rain or water hitting the surface.
- Security: integrated, miniaturised sensors for chemical/biological/radiological/explosive (CBRE) agents and for nanosystems that neutralise these agents.
- Environment: nanotechnology that eliminates harmful emissions from industrial processes; techniques to effectively remediate and/or treat environmental pollutants; novel sensing technologies or devices for pollutant and microbial detection.
- Biotechnology: Detection and manipulation of single molecules to provide fundamentally new information about biological processes; minimally invasive detection, diagnosis and management of disease and injury using technology platforms for biomolecular sensors which can function in the living body to measure, analyse and manipulate molecular processes.

Core Program

The course is a four-year program, including a significant research project in a nanotechnology area in the final year. It is designed for high calibre prospective students intending to become professional scientists and technologists. Honours are awarded to students whose academic performance exceeds a given level throughout their program. Students may graduate with first class, upper second class or lower second class honours.

The first two semesters provide a general foundation in Physics, Chemistry and Mathematics, and an introduction to the field of Nanotechnology. Students will choose to take two of the three available discipline streams (Chemistry, Physics and Molecular Biology) after completing Year 1 of the course. More advanced Nanotechnology units are included in years 2, 3 and 4 of the course for students in all discipline streams. At fourth year level the Honours program is available to students who achieve the required grades throughout the first three years of the degree. All students do research projects, but the Honours program includes a higher proportion of research-based work, with half of the final year’s assessment being based on a year-long research project.

Course Structure - Nanotechnology

Year 1

- Chemistry 101 or 112
- Physics 101 or 115
- Mathematics 101 or 103
- Science Communications 101
- Nanotechnology 101
- Chemistry 102 or 118
- Physics 102
- Mathematics 102
- Statistical Data Analysis 101
- Option Unit

Year 2

- Materials Chemistry 231

Year 3

- Nanotechnology Honours Dissertation 401 & 402 or Project 401 & 402

Optional Units Available

- Scientific Photography 101
- Materials and Technology 112
- Physical Properties of Solids 102
- Structure of Solids 104
- Chemical Energetics and Mechanisms 212
- Chemical Reactions and Equilibria 201
- Instrumental Analysis 301
- Applied Optics 302
- Quantum and Statistical Physics 301
- Materials Chemistry 331
- Materials Chemistry 332
- Statistical Data Analysis 301
- Mathematical Methods 301
- Environmental Chemistry 302
- Chemistry 401, 402
- Physics 302
- Physics 302
- Physical Properties of Solids 102
- Quantum Mechanics 401
- Bioinformatics 331
- Structural Bioinformatics 332
- Structural Chemistry 331

CORSIC Course Code: O4566D

Specialisations

All students choose two streams

Streams | Chemistry | Physics | Molecular Biology
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**Year 2**
- Chemical Structure and Spectroscopy 201
- Analytical Chemistry 202
- Chemical Reactions and Mechanisms 212
- Waves and Oscillations 201
- Physics 201
- Electromagnetism 302

**Year 3**
- Chemical Energetics and Thermodynamics 201
- Analytical Chemistry and Spectroscopy 301
- Electron Microscopy 301
- Solid State Physics 302
- Quantum and Statistical Physics 301
- Molecular Genetics 330
- Medicinal and Biological Chemistry 302
- General Genetics 202
- Quantum Mechanics 401
- Bioinformatics 331
- Structural Bioinformatics 332
- Structural Chemistry 331

**Year 4**
- Synthetic Methods in Chemistry 311
- Physio Optional Unit
- Molecular Genetics 330
- Medicinal and Biological Chemistry 301
- General Genetics 202
- Statistical Data Analysis 301
- Physical Properties of Solids 102
- Quantum Mechanics 401
- Bioinformatics 331
- Structural Bioinformatics 332
- Structural Chemistry 331

Related Areas of Study

- Astronomy
- Chemistry
- Geophysics
- Physics
- Engineering
- Medical Imaging Science
- Multidiscipline
- Forensic and Analytical Chemistry
Nano is derived from the Greek *nanos*, meaning dwarf and is a term used to describe things that are very small. The prefix “nano” means one billionth (10^{-9}), so a nanosecond is one billionth of a second, the time it takes for light to travel only 30 centimetres. One nanometre is one billionth of a metre – approximately the size of three silicon atoms side by side.

Entry Requirements

Local Students
Standard admission requirements to the University as well as the prerequisite TEE subjects Applicable Maths and Chemistry or Physics. Calculus is desirable. Selection is based on Tertiary Entrance Rank (ATAR). STAT not available.

More Information
scieng.curtin.edu.au

International Students
Standard university entry requirements, as well as high school completion of Advanced or Higher Mathematics and Chemistry or Physics.

More Information
international.curtin.edu.au

International Students
International students studying in Australia on a student visa can only study full-time and there are also specific entry requirements that must be met.

Please refer to international.curtin.edu.au or phone +61 8 9266 7331 for further information, as some information contained in this booklet may not be applicable to international students. Australian citizens and permanent residents, and international students studying outside Australia, may have the choice of full-time, part-time and external study. Information about TISC only applies to Australian residents.

Research Facilities

The Departments of Applied Chemistry, Applied Physics and the School of Molecular Biology are very well equipped with expert staff and facilities to undertake research and development in nanotechnology. Equipment available includes: Atomic Force Microscopes, Scanning Electron Microscopes, a Transmission Electron Microscope, a Small Angle X-Ray Scattering Facility, X-Ray Diffraction Equipment, and High-performance Computing Facilities.

Research in Nanotechnology

Research in nanotechnology is primarily carried out in the Materials Research Group and the Nanotechnology Research Institute. Curtin has acquired a wide range of state-of-the-art equipment suitable for imaging materials in the nanosize range. In addition, world-class staff have been appointed to teach and conduct research in this rapidly developing area. Nanotechnology research at Curtin is currently in areas such as nanocharacterisation, nanochemistry, nanomaterials design and applications, and biomaterials research and development.

Nanotechnology graduates who wish to study beyond bachelor level can continue in masters and PhD programs by research. Internationally recognised research institutes at Curtin offer projects in Nanotechnology-related research programs that integrate aspects of the disciplines of Physics, Chemistry and Molecular Biology.

Some examples are:
- Computational Nanochemistry
- Nanomaterials for Hydrogen Storage
- Nanoparticle Crystallisation
- Synthesis of Functional Molecules
- Biomimetic Materials
- Nanoscale Electrochemical Sensors
- Bioinformatics
- Molecular Diagnostics.

Good Reasons to Study Nanotechnology

1. Curtin’s four-year Nanotechnology degree provides all students with a double qualification in any two of the scientific disciplines of Physics, Chemistry and Molecular Biology.

2. Through research projects carried out within one of Curtin’s worldclass research institutes, all students get hands-on experience in the operation of advanced characterisation equipment relevant to the field of Nanotechnology.

3. The course is taught by academic staff who are inspired, enthusiastic and involved in nanotechnology research.

Adrian wasn’t particularly focussed on job prospects, he was more interested in the study of science itself. Nanotechnology, however, offered both. With equal focus on Maths, Chemistry and Physics most of the way through the degree (plus optional units), Adrian was able to get a broad science education within a well-structured course with fantastic job opportunities. The course has a solid practical side, with lab sessions in all Physics and Chemistry units. The close nature of the departments made him realise that there were no aloof academics but helpful, willing staff.

According to Adrian -

“all the teachers are real people.”

Adrian is currently doing his Honours in Nanotechnology, with a thesis titled Atomic Force Microscopy Characterisation of Lanthanoid Metal Organic Frameworks. He loves the fact his project has a balance of sciences, and allows him access to all areas. In the Chemistry labs he makes his own crystals – frameworks of metal atoms linked by organic molecular bonds – which are necessary for his experiments. He takes them and uses high-tech Physics equipment like the Atomic Force Microscope to measure distances between the individual atoms.

“It’s like a stylus on a record player but at an atomic level.”

For more, contact:

Science and Engineering
Curtin University of Technology
GPO Box U11987
Perth Western Australia 6845

Tel: +61 8 9266 1000
E: futurestudents@curtin.edu.au
W: futurestudents.curtin.edu.au

International enquiries
Tel: +61 8 9266 7331
Fax: +61 8 9266 2605
E: international@curtin.edu.au
W: international.curtin.edu.au

Adrian Murdock
“Ringmaster” of the Curtin Science Show

Curtin University
W: international.curtin.edu.au

Professional Accreditation:

The Australian Institute of Physics
Royal Australian Chemical Institute
www.rac.org.au

Curtin Innovation

Curtin University promises to be a leading edge university of technology. To fulfill this vision, we strive to be innovative and forward looking in everything we do. It’s in our approach to teaching and learning, it’s in our research, it’s in our staff, it’s in our students. It’s in our graduates. It’s in the way we think and act. It’s what we call Curtin Innovation.