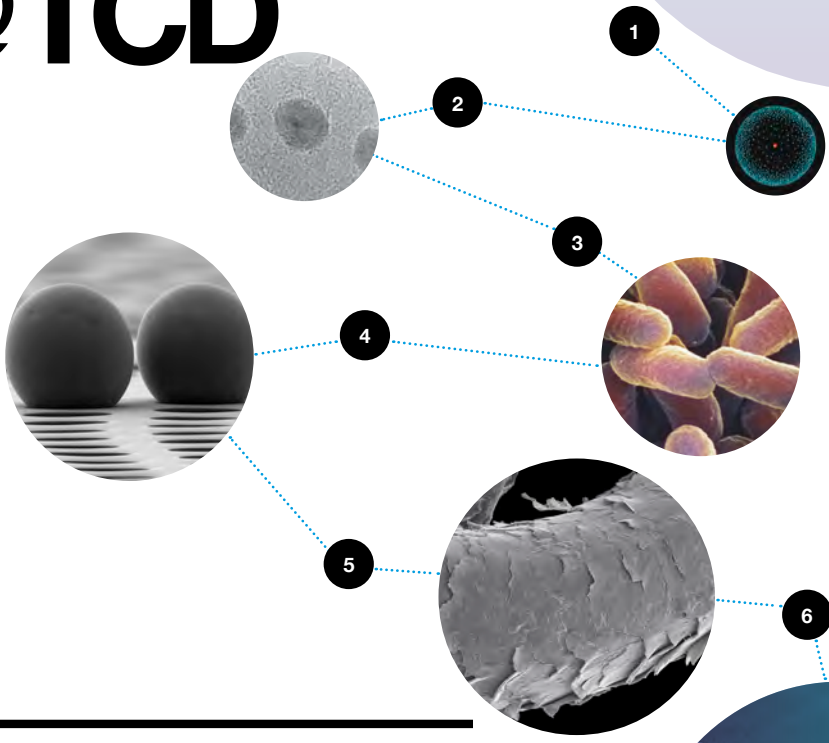
NANOSCIENCE @TCD



TR076 Nanoscience – Physics and Chemistry of Advanced Materials

Hydrogen Atom: 0.1 nm	1
Quantum Dot: 5 nm	2
E.Coli: 2,000 nm	3
Microsphere Laser: 3,000 nm	4
Width of Human Hair: 75,000 nm	5
Grain of Salt: 1,000,000 nm (1 mm)	6

TRINITY COLLEGE DUBLIN

www.tcd.ie/nanoscience/

ABOUT THE COURSE

Nanoscience, Physics and Chemistry of Advanced Materials (N-PCAM) is a four year honours degree course. Students will learn how to use and apply the principles of chemistry and physics to solve practical problems associated with the development of new technologies. The first two years, the Freshman Years, provide a solid foundation in Physics and Chemistry. In the last two years, the Sophister years, students study in detail a number of topics in Nanoscience. The course is offered jointly by the School of Physics and School of Chemistry. The course code in TCD is TR076.

WHAT IS NANOSCIENCE?

Nanoscience is the study of small scale matter, the minuscule building blocks of the material and biological worlds. Typically nanoscientists study materials of less than 100 nanometres. 1 nanometre is one billionth of a metre. Nanotechnologists are concerned with the behaviour of materials at these small dimensions and how they can be manipulated to do useful things.

Nanotechnology is being used to develop smaller and more powerful electronic devices, lasers, medical diagnostics and materials with completely new properties. Nanoscience is contributing to product innovation in virtually every field of manufactured goods, estimated to exceed $3 trillion in products globally by 2015. In Ireland we are well positioned to play a lead role in this nanotechnology revolution and are ranked 6th globally for the quality of the nanoscience research carried out in our universities, especially in TCD.

Nanoscience does not belong fully to either Physics or Chemistry. Therefore, a new approach is required. An interdisciplinary degree programme marries part of both subjects so that students gain a deep and lasting understanding of the science of advanced materials that underpins the nano revolution. This is the key for the development of our N-PCAM degree programme in Trinity College Dublin.

NANOSCIENCE AND ADVANCED MATERIALS

The ability to create new technologies or devices would not be possible without the use of advanced materials. Energy is an important issue for any new device, and making devices smaller approaching the nano-scale can reduce the energy cost, while increasing speed. Nanoscience incorporates applications in photonics, medical diagnostics, ultra-fast electronics and many other areas which in addition use advanced materials. Advanced materials include superconductors, polymers, lasers, magnets and optoelectronics and they can be found in applications ranging from computers and electronics, to telecommunications and broadcasting, to airlines and healthcare.

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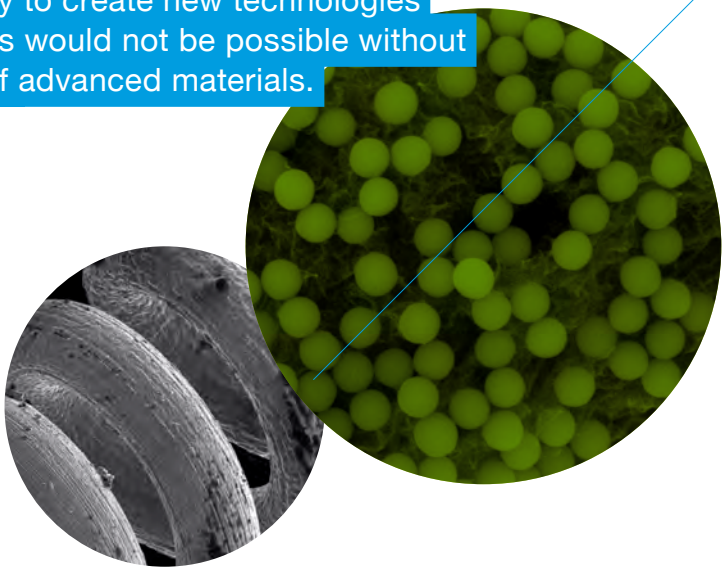

Six hours per week is spent in the specialised JS Nanoscience Teaching Laboratory.

COURSE MATERIAL

Junior Freshman & Senior Freshman

In the first two years, students take foundational modules in Physics, Chemistry and Maths. The modules include lectures, laboratory classes and problem solving tutorials. In addition to these standard courses there are specialized tutorial classes introducing students to the study of nanoscience.

Junior Sophister & Senior Sophister

In the Junior Sophister year (3rd year), students really begin to specialise in Nanoscience. Six hours per week is spent in the specialised JS Nanoscience Teaching Laboratory where they will be introduced to a wide range of techniques for the synthesis, preparation and characterisation of nanoscale materials. Some laboratory training is provided in CRANN, the nanoscience Institute (www.crann.tcd.ie) using their state-of-the-art facilities.

The Senior Sophister (fourth year) course further explores nanoscience and other topics. In this year, students carry out a major research project (3-5 months) where they become familiar with the applications of advanced materials, nanostructures or nanodevices in real-life situations. In most cases the project is pursued abroad in an academic or industrial research laboratory, and recent examples of laboratories where projects have taken place include the IMEC micro- and nano-electronics research centre in Leuven, Belgium; The Scripps Research Institute, La Jolla, California; the University of Alberta, Canada, and the University of Wollongong, Australia, and the University of Potsdam (Universität Potsdam), Germany.

CAREER OPPORTUNITIES

This degree will provide graduates with a flexible qualification for employment in cutting-edge high technology industries, such as the semiconductor, polymer and optical industries. Our graduates will be strongly sought-after in the knowledge economy where their interdisciplinary training in Physics and Chemistry will give them a clear edge in solving practical problems in high-tech industry. There are also opportunities to carry out postgraduate study in nanoscience, a key research area in Trinity College itself with world class facilities in CRANN, www.crann.tcd.ie . CRANN, the Trinity research institute dedicated to the study and applications of nanoscience, was pioneered by the Schools of Physics and Chemistry in Trinity College.

Graduates of the course are now working in a range of fields, including multinationals such as Intel, indigenous start-ups and in further academic research.

I completed my degree in Physics and Chemistry of Advanced Materials in 2008. During my final year I got the opportunity to undertake a short research project at the University of Wollongong, Australia. Developing this contact is probably the most life-defining outcome of the course for me, as it led to my PhD position in Australia. I found that PCAM, the nanoscience course, provided a very solid fundamental understanding of both physics and chemistry. This has allowed me to transition between fields and between projects, and to publish in both chemistry and physics journals. The course also placed a strong emphasis on developing physical models to explain new phenomena. These skills have been invaluable in my later research.

Cathal O'Connell, Former graduate
La Trobe University, Australia

For more case studies, go to
www.tcd.ie/nanoscience

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TRINITY COLLEGE DUBLIN

Trinity College Dublin is one of the great universities of the world and was ranked 61 in the world by the QS World University Rankings in 2013. It is widely recognized for the high quality of its graduates, the international standing of its research and scholarship, and the value it places on contributing to Irish society and the wider world.

Trinity College provides a liberal environment where independence of thought is highly valued. With a distinguished history, it also has all the facilities associated with a modern university. Located in the heart of Dublin, it has some 16,600 students and 2,900 staff. Students can experience a well-rounded University life through the range of clubs, societies, volunteer groups and other social activities.

In research, both the School of Physics and School of Chemistry have an excellent reputation around the world and several staff are recognised as leaders in their fields, particularly in nanoscience. Both Schools are affiliated and have access to state-of-the-art research facilities within CRANN (www.crann.tcd.ie), and are currently involved in the AMBER (Advanced Materials and BioEngineering Research) project funded by Science Foundation Ireland. This project provides a partnership between leading researchers in material science and industry. Both Schools are also major participants in the Trinity Centre for High Performance Computing, www.tchpc.tcd.ie/. Graduates from both Schools are in strong demand for a wide range of jobs in industry and commerce.

Located in the heart of Dublin city centre, Trinity has some 16,600 students and 2,900 staff.

SCHOOL OF PHYSICS

The study and teaching of physics at Trinity College has a long and distinguished history dating back to the 18th century and includes figures such as Hamilton, Lloyd, Fitzgerald and Walton, who made important contributions to physics. Ernest T. S. Walton was the first Irish-born recipient of a Nobel prize in Science (1951). The Sami Nasr Institute for Advanced Materials, completed in 2000, houses the central part of the School today. The two buildings provide excellent modern facilities for teaching and research for a very lively community of over 200, including 25 academic staff, more than 50 postdoctoral fellows and over 100 graduate students, representing nationalities from all over the world.

SCHOOL OF CHEMISTRY

The School of Chemistry at Trinity College has a rich history and celebrated its 300th year in 2011. Over the years, the School has expanded to its current staffing level of 38 (20 academic, 13 technical and 5 administrative staff) with an additional 35 postdoctoral research fellows and 100 postgraduate students. The School offers degree programmes in Chemistry, Medicinal Chemistry and Chemistry with Molecular Modelling. The School has an active research programme that spans all sub-disciplines of chemistry, and is involved in many inter-departmental and international research programmes. The School of Chemistry also participates in the Centre for Synthesis and Chemical Biology (CSCB), a chemical sciences research collaboration, run in conjunction with University College Dublin and the Royal College of Surgeons.

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ENTRY REQUIREMENTS

Nanoscience, Physics and Chemistry of Advanced Materials

- Course Code: TR076
- Points 2013: 570
- Points 2014: 595
  For current points see: www.tcd.ie/nanoscience/requirements
- Degree Awarded: B.A.

Special Entry Requirements

- Leaving Certificate
  - OA2 or HC3/Mathematics
  - HC3 in two of Physics, Chemistry, Biology, Physics & Chemistry, Applied Mathematics, Mathematics.
- GCSE: Grade A Mathematics or Advanced GCE (A-Level): Grade C Mathematics

Advanced GCE

- Advanced GCE (A-Level): Grade C in two of Physics, Chemistry, Biology, Mathematics, Applied Mathematics

Combinations not permitted:

- Physics & Chemistry with Physics or Chemistry
- Applied Mathematics with Mathematics

Individual course requirements are available at: www.tcd.ie/courses/undergraduate

International entry requirements are available at:
www.tcd.ie/international/apply/non-eu-undergraduate/

The School of Physics offers scholarships to incoming first year students, information is available on **physics.tcd.ie**