



### **Post Specification**

<b>Post Title:</b>	PhD Studentship: Nanoscale engineering of energy transfer via nanolithography, electron microscopy and electron energy-loss spectroscopy
<b>Post Status:</b>	Fixed Term (full-time): 3 years 11 months
<b>Research Group/Department/School:</b>	Hobbs Research Group, CRANN/School of Chemistry
<b>Location:</b>	CRANN/School of Chemistry Trinity College Dublin, the University of Dublin College Green, Dublin 2, Ireland
<b>Reports to:</b>	Dr. Richard Hobbs, Principal Investigator
<b>Salary:</b>	€16,000 gross per annum
<b>Closing Date and Time:</b>	September 12 <sup>th</sup> 2016 at 17:00 GMT

**NOTE: The successful candidate will be expected to commence as soon as possible in October 2016.**

### **Post Summary**

#### **Overview of the role**

Applications are invited for a PhD studentship at the School of Chemistry, Trinity College Dublin in the areas of electron microscopy, nanomaterials and plasmonics. The student will work with Dr. Richard Hobbs, a Royal Society-Science Foundation Ireland University Research Fellow at the School of Chemistry, Trinity College Dublin (<http://tinyurl.com/richardghobbs>).

Plasmonic metal nanoparticles can amplify optical fields resulting in locally enhanced light-matter interactions on the nanoscale. This property makes them a particularly



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attractive route to improve both the performance of photovoltaic devices and photocatalysts, and to scale the dimensions of optoelectronic devices. The decay of surface plasmons into hot electrons in metal nanoparticles, and the subsequent injection of those electrons into semiconductor nanoparticles and surfaces has been an area of significant interest recently with particular relevance to solar energy conversion and photochemistry. However, measuring and controlling the decay of plasmons on the nanometer scale has been a hurdle to the development of devices based on plasmonic nanoparticles. In this project, recently developed scanning transmission electron microscopy (STEM) and electron energy-loss spectroscopy (EELS) hardware will be used together with nanolithography to probe plasmon decay and energy transfer with higher spatial- and energy-resolution than previously possible. Specifically, high-resolution electron-beam lithography (EBL) will be used to place objects at controlled distances from plasmonic antennas having various geometries, to determine the dependence of energy transfer on the proximity to, and geometry of, plasmonic nanoantennas. Moreover, STEM/EELS will be used to measure the optical/electrical properties of semiconductor nanoparticles as a function their proximity to plasmonic antennas. The combination of nanometer placement control with EBL, and high spatial- and energy-resolution of STEM/EELS, will enable a greater understanding of how optical energy is converted in plasmonic systems. The results of this project will thus support the development of plasmon-enhanced photoelectric and photochemical devices.

The PhD candidate will acquire skills in electron microscopy, nanolithography and the synthesis of nanomaterials as well developing an understanding of the interactions of light and electron beams with matter.

### **Background to the Post**

Dr. Hobbs is a Royal Society-Science Foundation Ireland University Research Fellow at the School of Chemistry, Trinity College Dublin. His research explores the use of high-resolution nanolithography, electron microscopy and electron spectroscopy to



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develop novel nanomaterial systems for next-generation nanoelectronic, optoelectronic and photochemical devices. Dr. Hobbs holds a PhD in Chemistry from University College Cork where he worked in the field of semiconductor nanowire fabrication. Subsequent to his PhD research he worked as a Post-Doctoral Research Associate in the fields of ultrafast plasmonic photocathode development, nanolithography and electron microscopy and spectroscopy at the Research Laboratory of Electronics, Massachusetts Institute of Technology.

### **Standard duties and Responsibilities of the Post**

#### **Essential Duties**

- To conduct a specified programme of research under the supervision and direction of the Principal Investigator.
- Dissemination of research results in internal reports, peer-reviewed scientific journals and research conferences and seminars
- To work collaboratively with other members of the School of Chemistry and CRANN towards achieving the goals of the research programme.
- To develop skills in nanofabrication and electron microscopy

### **Selection criteria**

#### **Essential**

- The applicant should possess a first or upper-second class honours degree in chemistry, physics, materials science or other relevant discipline.
- They should be well-organised and self-motivated with the ability to manage the day-to-day running of a research project.
- The candidate will have excellent oral and communication skills, including the proven ability to write clearly and comprehensively in English for the preparation of written reports, publications and presentations of results.



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- The applicant should be willing to travel to collaborators and to conferences both nationally and internationally to disseminate results.

### Desirable

- Master's degree in chemistry, physics, materials science or other relevant discipline.
- Basic knowledge of plasmonic materials and underlying electromagnetic theory.

### Further Information for Candidates

The PhD studentship is open to both EU and non-EU candidates and will commence on October 1<sup>st</sup> 2016 with an end date of August 31<sup>st</sup> 2020. Funding will cover EU/non-EU tuition fees for the duration of the studentship as well as an annual stipend of EUR 16,000.

For additional details on this position please contact:

**Dr. Richard Hobbs**

**School of Chemistry**

**Trinity College Dublin**

**[rhobbs@mit.edu](mailto:rhobbs@mit.edu)**

URL Link to Department	<a href="http://www.crann.tcd.ie/">http://www.crann.tcd.ie/</a>
URL Link to Research Centre	<a href="http://ambercentre.ie/">http://ambercentre.ie/</a>
URL Link to Human Resources	<a href="http://www.tcd.ie/hr/">http://www.tcd.ie/hr/</a>

### CRANN Overview

The Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN) comprises a team of over two hundred and fifty researchers from 45 different



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countries, led by eighteen principal investigators and seventeen investigators, each of whom is an internationally recognised expert in his/her field of research. CRANN principal investigators are based across multiple disciplines including physics, chemistry, medicine, biochemistry and immunology, engineering and pharmacy. CRANN works at the frontiers of nanoscience developing new knowledge of nanoscale chemical and physical phenomena, with a particular focus on new device and sensor technologies for ICT, biotechnology and medical sectors.

CRANN hosts the new Science Foundation Ireland Research Centre AMBER- a €60M euro state-enterprise investment in material research and innovation. AMBER will partner with industry and academia in co-developing materials solutions. AMBER (Advanced Materials and BioEngineering Research) is a Science Foundation Ireland funded centre that provides a partnership between leading researchers in material science and industry. It is jointly hosted in Trinity College Dublin (TCD) by CRANN and the Trinity Centre for Bioengineering (TCBE), in collaboration with University College Cork and the Royal College of Surgeons in Ireland (RCSI).

This centre will deliver internationally leading materials research that will be industrially and clinically informed with outputs including new discoveries and devices in ICT, medical device and industrial technology sectors. AMBER has a strong emphasis on linking industry to research programmes and the aim of the centre is to develop products that directly impact everyone's quality of life such as the development of the next generation computer chips and new medical implants and pharmaceuticals that will improve patient care. AMBER brings together Ireland's leading material science researchers working across the disciplines of Physics, Chemistry, Bioengineering and Medicine; with an international network of collaborators and companies.



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CRANN has two state-of-the art buildings both custom designed and constructed for the purpose of leading edge nanoscience research. The Naughton Institute is a 6000m<sup>2</sup> research facility on the campus of TCD. The CRANN Advanced Microscopy Laboratory (AML) was completed in 2009. This facility is on Pearse Street and houses Ireland's most advanced microscopy instrumentation, enabling Ireland to compete internationally in terms of this capability. The impact is being measured in terms of Ireland 8<sup>th</sup> place ranking in materials science, of which over 70% of the cited publications are linked to CRANN and its partner schools.

Through its SFI funded Centre for Science, Engineering and Technology (CSET), CRANN has a specific remit to work with industry. CRANN presently has active research engagement with over seventy companies in Ireland and Europe, including multinationals such as Intel and HP and indigenous companies such as Cellix and Eblana Photonics. CRANN has also been very successful in obtaining non-Exchequer funding (e.g. European Union Frameworks) that enabled the establishment of an extensive academic partnership network involving over 100 European universities and 160 universities globally.

On a national basis, CRANN leads the INSPIRE consortium ([www.inspirenano.com](http://www.inspirenano.com)) which comprises the foremost nanoscience researchers in Ireland based across eight academic institutions. CRANN, in partnership with the Tyndall National Institute, will co-host the Competence Centre for Applied Nanotechnology. This is a new initiative to enable research provider organisations to partner one another on an industry defined research programme.

CRANN has been funded predominately by Science Foundation Ireland and has also obtained competitive funding from the Higher Education Authority, Enterprise Ireland, industry, the EU commission through FP6 and FP7 and philanthropic sources, notably Dr. Martin Naughton.



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## **Trinity College Dublin, the University of Dublin**

Founded in 1592, Trinity is at the nexus of tradition and innovation, offering undergraduate and postgraduate programmes across 24 schools and three faculties: arts, humanities, and social sciences; engineering, maths and science; and health sciences. Spread across 47 acres in Dublin's city centre, Trinity's 17,000-strong student body comes from all 32 counties of Ireland, and 16% of students come from outside the country. Of those, 40% are from outside the European Union, making Trinity's campus cosmopolitan and bustling, with a focus on diversity.

As Ireland's leading university, the pursuit of academic excellence through research and scholarship is at the heart of the Trinity education. Trinity is known for intellectual rigour, excellence, interdisciplinarity, and research-led teaching. Home to Nobel prize-winners such as scientist Ernest Walton and writer Samuel Beckett, Trinity draws visitors from across the world to its historic campus each year, including to the Book of Kells and Science Gallery which capture the university's connection to both old and new.

Trinity accounts for one-fifth of all spin-out companies from Irish higher education institutions, helping to turn Ireland into an innovation-intensive, high-productivity economy. That culture of innovation and entrepreneurship is a defining characteristic of our campus as we help shape the next generation of job creators.

Trinity has developed significant strength in a broad range of research areas, including the 19 broadly based multi-disciplinary thematic research areas.



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Ireland's first purpose-built nanoscience research institute, CRANN, houses 150 scientists, technicians and graduate students in specialised laboratory facilities. Meanwhile, the state-of-the-art Biomedical Sciences Institute is carrying out breakthrough research in areas such as immunology, cancer and medical devices.

The Old Library, which houses the Long Room, in Trinity is the largest research library in Ireland, with a collection of six million printed items, 500,000 maps, 80,000 electronic journals, and 350,000 electronic books. Some of the world's most famous scholars are graduates of Trinity, including writer Jonathan Swift, dramatist Oscar Wilde, philosopher George Berkeley, and political philosopher, and political theorist Edmund Burke. Three Trinity graduates have become Presidents of Ireland - Douglas Hyde, Mary Robinson and Mary McAleese.





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Trinity is the highest ranked university in Ireland, and among the world's leading higher education institutions.

### Trinity College Dublin World University Rankings

#### Overall

- Trinity is Ireland's No.1 University in the QS World University Ranking, THE World University Ranking and the Academic Ranking of World Universities (Shanghai).
- Trinity is ranked 71<sup>st</sup> in the World and 21<sup>st</sup> in Europe in the 2013/2014 QS World University Ranking across all indicators.

#### Internationalisation

- Trinity is ranked 44<sup>th</sup> in the World in the Times Higher Education Top 100 Most International Universities.
- Trinity is 46<sup>th</sup> in the World in the QS World University Ranking 2013/2014 in terms of International Faculty.

#### Research Performance

- Trinity is ranked in the top 70 universities in the world in the Times Higher Education Ranking of World Universities in terms of overall research and in the top 75 universities in the world in terms of citations (research impact).
- Trinity ranks in the top 1% of research institutions in the world in the following 17 Essential Science Indicators fields (an increase of over 150% from 2004): Physics, Chemistry, Engineering, Social Sciences (General), Immunology, Neurosciences, Nanosciences, Materials Science, Pharmacy and Toxicology, Molecular Biology and Genetics, Biology and Biochemistry, Microbiology, Plant and Animal Science, Clinical Medicine, Agriculture, Psychiatry/Psychology, Environment/Ecology.



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### **In the QS Faculty Rankings 2015\*:**

- Trinity is ranked 63rd in the world in Arts and Humanities.
- Trinity is ranked 69th in the world in Life Sciences and Medicine.
- Trinity is ranked 89th in the in Social Sciences and Management.

### **In the QS Subject Rankings 2015\*\*:**

Trinity College Dublin features in the world's elite (Top 200) institutions in 25 of the 28 subjects in which it was evaluated by the QS World University Rankings by Subject 2015. Of these, Trinity ranks in the top 100 in the world in 14 subjects and in the top 5 in the world in 5 subjects.

#### **Top 50**

- Trinity is ranked 32<sup>nd</sup> in the world in English Language and Literature.
- Trinity is ranked 33<sup>rd</sup> in the world in Politics and International Studies.
- Trinity is ranked 39<sup>th</sup> in the world in History.
- Trinity is ranked 48<sup>th</sup> in the world in Biological Sciences.
- Trinity is ranked 49<sup>th</sup> in the world in Modern Languages.

#### **Top 100**

- Trinity is in the top 100 in the world in Chemistry.
- Trinity is in the top 100 in the world in Computer Science and Information Systems.
- Trinity is in the top 100 in the world in Education.
- Trinity is in the top 100 in the world in Geography.
- Trinity is in the top 100 in the world in Law.
- Trinity is in the top 100 in the world in Medicine.
- Trinity is in the top 100 in the world in Pharmacy and Pharmacology.
- Trinity is in the top 100 in the world in Philosophy.



- Trinity is in the top 100 in the world in Psychology.

**Trinity subjects ranked in the world top 101-200 (QS Subject Ranking 2015)**

Subject	Trinity Rank
Accounting and Finance	101-150
Business and Management Studies	101-150
Economics and Econometrics	101-150
Linguistics	101-150
Physics and Astronomy	101-150
Sociology	101-150
Engineering - Civil and Structural	151-200
Engineering – Electrical	151-200
Engineering – Mechanical	151-200
Environmental Sciences	151-200
Mathematics	151-200

\* QS ‘Faculty’ Rankings 2015: [www.topuniversities.com/faculty-rankings](http://www.topuniversities.com/faculty-rankings)

\*\* QS Subject Rankings 2015: [www.topuniversities.com/subject-rankings](http://www.topuniversities.com/subject-rankings)

**Equal Opportunities Policy**

Trinity College Dublin, the University of Dublin is an equal opportunities employer and is committed to the employment policies, procedures and practices which do not discriminate on grounds such as gender, civil status, family status, age, disability, race, religious belief, sexual orientation or membership of the travelling community.



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### Application Procedure

Interested candidates are invited to contact Dr. Richard Hobbs by email with an up-to-date copy of their C.V. together with a brief cover letter outlining their relevant experience and suitability for the role by September 12<sup>th</sup> 2016.

Name: **Dr. Richard Hobbs**  
Title: **Royal Society-Science Foundation Ireland University  
Research Fellow**  
Email Address: **rhobbs@mit.edu**

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