

Report on the EpitopeMap sponsored conference: **Bionano: Inspiring Responsible Development for Society and the Environment**

1) Summary

Nanotechnologies are an enabling technology and will impact on products and industrial processes across all industrial sectors, from IT, biomedical, food, cosmetics, agriculture, energy and others. Prior to the current economic downturn, projections for sales of products incorporating emerging nanotechnology suggested they would be 15% of global manufacturing output by 2014, totalling \$2.6 trillion. Europe has invested very heavily in nanotechnologies over recent years, and there is an urgent need to protect this investment by ensuring that scientific advances are converted into economic and social advances, whilst also ensuring that the development of products using or incorporating these technologies does not have an inadvertent negative impact on the environment or on human health.

The aim of the EpitopeMap co-funded BioNano conference was to highlight some of the key opportunities presented by nanotechnology in light of the present worldwide economic difficulties, and to re-engage with the excitement of the earliest days of nano-research. A key focus was given to applications and innovations of nanotechnology that improve the quality of life of European citizens and can help to drive the knowledge economy, and thus, the title “Bionano: Inspiring Responsible Development for Society and the Environment” was chosen to reflect this ethos and to try to capture the excitement of the recent developments in nanotechnology for the current generation of young European and Irish Researchers. Four topics were chosen for the meeting, each highlighting a specific aspect of bionanointeractions, and the interconnect between fundamental understanding and application, and each represented by a key note lecturer of international standing, as follows:

NanoCommunication: *Trajectories in Public Opinion Nanotechnology* by **Jane Macoubrie** from the Project on Emerging Nanotechnologies.

NanoSafety: *Nanosafety approaches, development and inclusion* by **Maria Dusinska** from the Norwegian Institute for Air Research.

NanoMedicine: *Nanotechnology Health and Medicine* by **Ruth Duncan** from Cardiff University

NanoGreen technologies: *Nanochemistry for photovoltaic's* by **Denis Fichou** from the Centre National de la Recherche Scientifique.

The conference was organised as a 2 day event, held at the Carlton Airport Hotel in Dublin, Ireland on the 15th and 16th October 2009, and was attended by over 100 delegates, from Ireland, Europe, the US and from several Governmental Agencies, Embassies and NGOs, as indicated in the participants list. The conference was organised and co-funded by members of the Irish government-funded Integrated NanoScience Platform for Ireland (INSPIRE) and as such also had some flavour of the national landscape here, where we are leading in the arena of bionanoscience, and in particular in terms of the development of the concept of the nanoparticles-protein corona, which is becoming increasingly recognised internationally as the key mediator of how nanoparticles interact with living systems. This emphasis on bionanointeractions, and the importance of mapping the outer layers of the adsorbed proteins is also a key goal of the ESF Network EpitopeMap, and as such the conference offered an excellent opportunity for the EpitopeMap partners to present their research to a wider community in the nano-arena. An EpitopeMap Steering Committee meeting was held in association with the conference.

2) Description of the scientific content of and discussion at the event

Recent research now suggests that nanoparticles can actively transport to essentially every location in the body. A growing 'rule of thumb' suggests that nanoparticles of less than 100nm typically enter cells, those of less than 40 nm can enter the nucleus, and that nanoparticles of less than 35 nm may pass through the Blood Brain Barrier and enter the brain. Thus, study of the interactions between nanoparticles and living matter is in the process of opening up fundamentally new opportunities in medicine and diagnostics. This knowledge equally imposes on us the necessity for consideration, without excessive and unscientific alarm, of key safety issues in implementing nanoscience overall.

As nanoparticles become more and more prevalent, and applications of nanoparticles in medical devices and as drug delivery vehicles become commercial realities, human exposure to nanoparticle will increase drastically. Thus interest and concern regarding the safety of nanoparticles is an issue that is gaining attention, and for which very few answers exist at present. The paradigm of the nanoparticle protein corona, where the role of the biomaterial surface may only be relevant in terms of the proteins it induces to adsorb, might have particular significance in understanding the interactions of nanoparticles with biological cells. Nanoparticles are simply biomaterials of smaller dimensions and higher curvature than conventional biomedical biomaterials, thus the scientific issues are the same as those that have been extensively investigated by biomedical researchers and industries.

The ESF EpitopeMap Research Networking Program brings together scientists working in the traditionally separate areas of biomaterials and nanoparticles, in order to develop and apply the most cutting-edge characterization techniques to understanding the nature of the surface-adsorbed protein layer on biomaterials and nanoparticles, and the effect of this on biocompatibility and nanoparticle toxicity. Envisaged highlights of the program include the exchange of ideas between the traditionally distinct research areas and the bringing together of a range of physical (characterisation and visualisation) techniques with biological and medical approaches to addressing the common goals, which will result in a great increase in the pace of understanding, a rational basis for risk assessment, and a reduction in the barriers to developing commercial applications of biomaterials and nanoparticles. The Bionano: Inspiring Responsible Development for Society and the Environment conference was a key step in achieving these goals, and in further probing the implications of protein-nanoparticle interactions as the mediators of biocompatibility, biomedical targeting and nanodiagnostics.

The Integrated NanoScience Platform for Ireland (INSPIRE) platform creates a national integrated nanoscience and nanotechnology activity which is resulting in increased collaborations across the nanoscience community nationally, leverage of existing capabilities and elevation of national activity to internationally leading levels. The three key research domains in INSPIRE are: Nanoelectronics, Nanophotonics and Bionanoscience. The bionanoscience strand of INSPIRE co-sponsored the conference, promoting the further mapping of the national research agenda onto the ESF and European research agendas, and helping to promote Ireland as a centre of excellence in bionanoscience, and bionanosafety.

The joint ESF EpitopeMap / INSPIRE Conference aimed to highlight some of the key opportunities presented by nanotechnology in light of the present worldwide economic difficulties, and to re-engage with the excitement of the earliest days of nano-research. A key focus was given to applications and innovations of nanotechnology that improve the quality of life of European citizens and can help to drive the knowledge economy, and thus, the title "Bionano: Inspiring Responsible Development for Society and the Environment" was chosen to reflect this ethos and to try to capture the excitement of the recent developments in nanotechnology for the current generation of young European and Irish Researchers.

The overall aims of the conference were –

- To attract international experts in the field;

- To showcase INSPIRE BioNano activities and highlight the vibrancy and energy in this research arena in Ireland;
- To broaden and expand the BioNano community nationally;
- To build increased engagement of scientists with policy and regulatory bodies in Ireland and beyond.

The target audience for the conference was students and postdoctoral researchers, as well as the wider stakeholder groups, including industry, NGOs, governmental agencies interested in aspects of regulation of nanomaterials and the general public. As can be observed from the delegate list, the conference succeeded in attracting a diverse audience, and consisted of 110 delegates, from academia nationally and internationally (UCD, DIT, TCD, DCU, ITT, UCC, NUIG, UL, AIT, WIT, DIT, NUI-Maynooth, QUB, UU, Cardiff Univ., Univ. Trieste, Univ Paris, New Univ. Lisbon, Univ. Cyprus, Univ. Porto, Univ Leuven, Ludwigs Maximillian Univ., VTT, Univ. California), policy and regulatory agencies (Health and Safety Authority, Food Safety Authority, Irish Medicines Board, Department of Agriculture, Department of the Environment, Food and Drug Law institute (US), Norwegian Institute of Air Research, ESF), industry (Fisher Scientific, Hewlett Packard, Hitachi, Intel, Alpha Technologies, Biosciences, Oriflame, Perkin Elmer) and some more general public representatives (Russian Embassy, Spanish Embassy). The full details of the participants are provided in the attached participants list.

The choice of the four main topics for the conference was based on our assessment of the key areas for development and areas offering most opportunities for young researchers. They were based on a review of the growth areas in terms of research publications, research meetings and policy requirements, and the selected four topics were as follows:

Nanomedicine, which is the medical application of nanotechnology for therapeutic intervention and disease diagnosis. Nanotechnology has expanded the approaches available to doctors to detect, treat and monitor diseases. Nanotechnologies ranging from the use of nanomaterials in drug delivery, tissue regeneration, drug detection and in vivo imaging technologies to nanoelectronic biosensors for monitoring and treating disease to future applications of molecular nanotechnology were showcased in this area of the BioNano conference.

Nanosafety, which is concerned with the safe implementation of nanotechnologies, and ensuring that the promise of nanotechnology is not compromised by inadvertent health consequences in years to come. Current problems for nanomedicine and nanogreen technology involve understanding the issues related to toxicity and environmental impact of nanoscale materials. Thus this section of the BioNano conference focused on reaching a better understanding of the unique properties of nanomaterials, compared to their bulk counterparts. Nanoparticles (particles <100 nm diameter) appear to have toxic effects that are unusual and not seen with larger particles. How easily nanoparticles can enter the body and how cells behave when they come into contact with nanoparticles of different shape, composition and size is of extreme interest. The goal of this part of the conference was to highlight recent efforts and strategies to determine whether and to what extent nanomaterials and nanobio technologies may pose a threat to the environment and all living species, and the development of strategies to ameliorate such negative health or environmental impacts.

NanoGreen technologies are technologies that exploit the advances of nanotechnology in industrial applications to reduce cost of production, the pollution of our environment and the consumption of our natural resources, e.g. nanoparticles in solar cells. Here the goal was to attract researchers with unique insights into nanotechnology and its impact on green 'processing', including green synthesis of nanoparticles, utilisation of nanotechnologies in farming and food, and use of nanotechnology-based solar energy conversion approaches.

NanoCommunication focuses on the public's knowledge and perceptions of nanotechnology and how these perceptions may shape the development of nanotechnology in Ireland and beyond. This section of the conference aimed at broadening the overall understanding of communication issues for the young researchers, and the importance for them to be able to convey their research to the lay public in a meaningful manner, convey the important scientific advances without being over technical. This section was intended to also attract researchers

with a particular interest in nanoscience and nanotechnology education at all levels. As such social scientists and educational experts were also invited to participate in the conference.

A balance of invited international speakers giving the plenary and keynote presentations, and invited lectures from Irish and ESF EpitepeMap participants was complemented by a selection of short talks from young researchers chosen from the abstracts submitted to the open call for abstracts. Focus was given to ensuring ample presentation opportunities for presenting to PhD students and young postdoctoral researchers, to promote their training and development and enhance their CVs. Interestingly, the majority of abstracts submitted fit into the nanosafety topic (reflecting its current importance and the fact that resolution of these issues and the uncertainty surrounding the safety of nanomaterials) and nanomedicine, with less in the contiguous areas of nanodiagnostics. As nanogreen technologies are in a very early emergent stage, the range of abstracts submitted here was impressive, as reflected in the final programme (section 4). This also reflects the need for basic scientists to engage further and more effectively with engineering and more applied approaches, in order for the two communities to merge ideas more effectively, and to progress the overall research aims of applying nanotechnologies for practical solutions for a greener world. A regulatory perspective was provided also, via a presentation from Karen Rodgers of the Health and Safety Authority (HSA) in Ireland on *“Occupational Health and Safety Considerations for Nanomaterials”*. Over 40 posters were presented, and the authors were provided the opportunity to give a 3 minute oral “flash presentation” to highlight their work in advance of the poster sessions, and this session was lively, interesting, and appreciated by both the audience and the poster presenters.

The opening keynote lecture was given by Prof Daniel Morse from the University of California, Santa Barbara, highlighting *“Nanotechnology in Nature”*, and how we can learn from natural structures and organisms to develop biomimetic technologies on a nanoscale. This lecture was very inspirational, and engendered a very lively discussion following Daniel’s presentation. The scope of the talk was wide-ranging, and showcased a wide basis for nanotechnology to develop bio-mimetic structures and functional forms to address a variety of challenges. Prof. Morse discussed the use of gene cloning, recombinant DNA and protein analyses, gene- and protein-engineering, site-directed and combinatorial mutagenesis and biomimetic peptide synthesis in conjunction with advanced imaging technologies (including the latest developments in atomic force microscopy, X-ray diffraction, solid-state NMR and laser-confocal immunohistochemistry) to reveal the mechanisms controlling the biosynthesis and supramolecular self-assembly of the high-performance mineralized composites of molluscan shells and pearls, the skeletons of corals, and the silica structures made by marine sponges and diatoms.

The lecture by Jane Macoubrie from the Project on Emerging Nanotechnologies on the topic of *“Trajectories in Public Opinion Nanotechnology”* presented an investigation of how public perception of new technologies changes as the level of information available increases. She also presented data on group dynamics in decision making, and how this can impact on public perception. Several lessons can also be learned from the public reaction to GMOs and other technologies. Approaches used in Jane’s research include face-to-face and Internet mediated communication processes for citizen involvement in policymaking, focusing on communication variables influencing effective processes.

The keynote lecture in the Nanosafety topic, by Maria Dusinska from the Norwegian Institute for Air Research, covered the state of the art research in assessing the safety of nanomaterials. In her talk *“Nanosafety approaches, development and inclusion”* Maria discussed the need for detailed protocols, for consideration of the potential impacts of nanomaterials on the conventional toxicology tests, and presented data from the EU FP7 project NanoTest, which is examining the potential genotoxicity of a range of nanomaterials. Several of these topics were picked up in the later presentations in this theme, including by Dr. Iseult Lynch, who presented data from the EU FP6 NanoInteract project, which focussed on the interactions between nanomaterials and living systems, and the role of the protein corona in mediating these interactions.

Prof. Ruth Duncan from Cardiff University gave an excellent overview of the arena of nanomedicine, and presented the background ideas and examples from her own and other state of the art research, in her talk "*Nanotechnology Health and Medicine*". Ruth presented ideas regarding the origin of the descriptor "polymer therapeutics", which is an umbrella term coined to describe polymeric drugs, polymer-drug conjugates, polymer-protein conjugates, polymeric micelles to which drug is covalently bound, and multi-component polyplexes being developed as non-viral vectors. Novel polymer architectures (e.g. dendrimers), biodegradable polymeric carriers incorporating the drug via pendant linkage or as a component of the polymer main-chain are being explored. Constructs are also being explored as a means to improve tissue repair. Many classes of polymer therapeutic are now at the clinical stage of development or in the market. The follow-on talks in this session picked up on these themes and gave further insights into the area and the latest research trends.

The session on NanoGreen Technologies was opened by Prof. Denis Fichou from the Centre National de la Recherche Scientifique who gave a keynote lecture for "*Nanochemistry for photovoltaics*". The talk was a wide-ranging overview of the use of nanotechnology for energy capture and storage, focussing on tailoring of supramolecular self-assemblies on atomically flat surfaces and their implementation as active materials in transistors and solar cells. The use of Scanning tunneling microscopy (STM) and spectroscopy (STS) in this research was also presented. The follow-on talks covered issues such as energy capture in low- or diffuse sunlight areas (such as Ireland) and other approaches for energy capture, such as organic polymers.

The work of the partners in the ESF Epitepemap was represented by presentations in three of the four topical areas - Theodora Krasia-Christoforou from the University of Cyprus gave a talk on "*Magneto-responsive polymer micelles based on Iron Oxide Nanoparticles and Diblock Copolymers with β -Ketoester Functionalities: Fabrication, characterization and in vitro Biocompatibility*" in the nanosafety theme; Joachim Rädler from Ludwig Maximilians-University Munich gave a talk on "*BioInspired NanoSystems for Gene and Drug Delivery*" in the nanomedicine theme, which picked up on several of the ideas raised by Prof. Morse in his plenary lecture; and Markus Linder from the Technical Research Centre in Finland (VTT) presented some ideas regarding "*Engineered proteins for bionanomaterials*" in the nanogreen technologies theme, again echoing the idea of bio-inspired materials and the need for sustainable and clean approaches to nanotechnology to ensure that the nano-enabled processes and products developed help to contribute to a greener, cleaner planet for future generations. These presentations spanned the range of expertise and activities that are on-going within the ESF Epitepemap programme, and the invitation was given to all conference participants to participate in the ESF Epitepemap programme further, through exchange and short visits to the partner laboratories and other laboratories to conduct projects related to the topic of understanding the role of proteins in mediating nanoparticle interactions with living systems. This message was also re-iterated by the ESF Epitepemap programme officer, Ms. Chantal Durant, who opened the second day of the meeting with a short presentation of the ESF and its scientific activities and funding opportunities. Thus, an addition outcome of the meeting was an increased awareness of the ESF and its scientific activities among the national and European participants.

Overall, the organising committee felt that the conference was a real success, achieved more than it set out to, and set an excellent standard for future meetings on this topic, within Epitepemap / INSPIRE, and beyond.

3) Assessment of the results and impact of the event on the future direction of the field

The quality of the presentations and the discussions following and between the lectures was excellent, and was remarked on by several of the international and young researchers. The mixture of hard sciences and the more social science aspects such as nanocommunication and nanoeducation was also greatly appreciated, as was the arranging of the programme such that this session was up-front at the start of the meeting, when the maximum number of delegates were present, rather than being given a niche status at a less desirable time-slot in the programme. Many of the participants and keynote/plenary speakers took the time to write to the organisers following the meeting to express their thanks for the meeting. A couple of examples of the feedback received are presented below:

“Thank you again - and congratulations - for the terrific conference! It was both a pleasure and a privilege for me to participate, and I especially enjoyed catching up with you and your colleagues again” – Prof Daniel Morse

“Many thanks for inviting me to the Dublin conference. As you ponder where to go next, keep me in mind as I would love to continue participation”- Dr Jane McCoubrie

Several new research linkages were developed, both within Ireland, between Ireland and the European partners in the ESF EpitepeMap RNP, and with other international researchers who had not previously been aware of the EpitepeMap or INSPIRE programmes. Whether these will lead to durable outcomes and generation of new projects and new funding remains to be seen, but the signs are encouraging, and EpitepeMap and INSPIRE will proactively encourage and foster these linkages.

Increased awareness of the EpitepeMap Research Training Network, and the European Science Foundation in general was also developed, as evidenced by the increased number of applications for short and exchange research visits experienced by the EpitepeMap programme since the conference. We have also had several enquiries as to how we can add additional countries (including the UK, Portugal, Norway and Slovenia) to the EpitepeMap network, and we are liaising with these countries to push forward this agenda. This has already led to several new EpitepeMap travel grant and exchange grant applications.

The promotion of opportunities for postgraduate students and postdoctoral fellow to interact, and to see their research being places in a wider context, via the plenary and key-note lectures, was also very important, as it ensures that the students and postdocs gain a wider perspective on their research, its relevance to wider society and their role in the science-policy and science-society debates. The meeting also provided ample opportunity for students and postdoctoral researchers to share their research goals and results, via the 3-minute poster presentations and the poster sessions, which also facilitated establishment of new research collaborations at the research level, as well as fostering new project ideas developed by the young researchers themselves.

Based on the level of interest in the event, both from the scientific community itself, and from other stakeholders in the nanotechnology revolution, such as the regulatory bodies, industry, science and education communicators and the general public, it has been decided to establish this event as a semi-annual event, with the topics for each year, and the balance between the topics being established via the same process as used for this meeting – i.e. an assessment of the growth areas via publication rates to suggest the initial topics, and the balance of the final programme being determined based on the proportional representation of the abstracts submitted, applying also a quality indicator to ensure that the conference maintains the highest international standards. The location of the future events has not yet been determined, and will likely depend on the co-funders. INSPIRE will likely remain an active driver of the organisation of the semi-annual events, and will continue to see co-funding from ESF (via EpitepeMap or other related programmes).

Several emerging themes resulted from the conference, including:

- The very significant complexity in nature which offers an enormous range of opportunities for development of engineered materials to mimic these functions and develop materials with similar properties for use in a wide range of applications (biomimetic materials). This theme was picked up by Anika Moestart who presented her work on natural adhesives extracted from slime, which have fibrillar protein structures, providing them with considerable adhesive properties, as stretching of these materials results in sequential breaking of protein-protein interactions via a saw-tooth type mechanism. Such adhesives have applications as “green glues” for example, and also teach us that nature often uses similar structural motifs for both pathogenesis (e.g. the fibrillar structures that form amyloid plaques in Alzheimer’s and Parkinson’s diseases) and for positive functionalities such as the adhesive properties described.
- This theme of positive and potentially harmful effects was also picked up in both the nanosafety and nanomedicine sections, both of which are underpinned by the need to understand the fundamental interactions between nanoparticles and living systems. In the case of nanomedicine, this understanding will enable researchers in the future to be able to develop strategies to specifically target nanoparticles to diseased cells, delivering a targeted dose of therapy to the diseased site, and ensuring that un-damaged tissue is not harmed. This same understanding will enable researchers using nanoparticles not intended for biological use, such as nanoparticles designed for use in the information technologies industry and in solar cells, to develop particles that do not engage with the biological machinery, or interact in such a way that they are rapidly cleared and do not reach any vulnerable sites or bioaccumulate to concentrations that could potentially be harmful. Thus, the focus on mechanistic understand to enable design and re-design of particles for specific functions was a key emerging theme, that will be picked up in the next conference. This also reflects the needs of industry and regulators to have a toolkit of approaches to assess likely impacts of nanomaterials of different types.
- The potential for nanotechnologies to assist with the creation of a greener world was an important theme, and in order to achieve this, alternative routes to synthesis of nanoparticles are also needed, which do not use harsh or petroleum based chemicals. Obviously significant work is needed here, although steps in this direction are already been made, as reflected by the synthesis approach being pioneered by Eulália Pereira, from the Universidade do Porto. Incorporation of green nanoparticles into solar cells would be a real advance, especially if improved energy conversion and storage efficiencies could also be obtained.
- Communication and education were highlighted in several talks, and the importance of these as tools to ensure the public acceptance of nanotechnologies cannot be overemphasized. The successful realisation of the large investment in nanotechnologies in Europe is contingent on our ensuring that they are safe, and in ensuring that the public understand the issues involved, and have a balanced view of the benefits and (potential) risks. Clear, honest and not overly simplified communication strategies are key to achieving this, and should be considered the responsibility of all scientists. However, training in these aspects of communication and education are lacking, and should be integrated into PhD researchers training from an early stage.

4) Final programme of the meeting

Programme Thursday 15th October

8.45am – 9.15am **Registration**

WELCOME AND PLENARY TALK

9.15am - 9.30am **Welcome and Opening Remarks**

Hugh J. Byrne
Director, Focas Institute, DIT

9.30am - 10.00am **Keynote Lecture**

Nanotechnology in Nature

Professor Daniel Morse
University of California

NANOCOMMUNICATION

10.00am - 12.30pm **Session 1 Oral Presentations: NanoCommunications**
Chairs: Hugh J. Byrne & Theodora Krasia-Christoforou

10.00am - 10.30am *Trajectories in Public Opinion & Nanotechnology*

Jane Macoubrie
The Project on Emerging Nanotechnologies

10.30am – 11.00am **Flash Poster Presentations**

11.00am – 11.30am **Coffee and Poster Session**

11.30am - 11.50am *Nanotechnology and public perceptions Ireland*

Laura Walsh
Focas Institute, DIT

11.50am - 12.10pm *7 Reasons Ireland Needs to Talk about Nanotechnology*

Padraig Murphy
Dublin City University, DCU

12.10pm - 12.30pm *Can I be a specialist in nanotechnology?*

Nicolas Battard
Dublin Institute of Technology, DIT

12.30pm - 2.00pm **Lunch - Poster Session & Trade Stands**

NANOSAFETY

2.00pm - 5.00pm	Session 2 Oral Presentations: NanoSafety Chair: Joachim Radler
2.00pm - 2.30pm	<i>Nanosafety approaches, development and inclusion</i> Maria Dusinska Norwegian Institute for Air Research
2.30pm - 2.50pm	<i>Methods of determination of nanoparticle effect?</i> Iseult Lynch Centre for BioNano Interactions, UCD
2.50pm - 3.20pm	Flash Poster Presentations
3.20pm - 3.50pm	Coffee and Poster Session
3.50pm - 4.10pm	<i>Occupational Health and Safety Considerations for Nanomaterials</i> Karen Rodgers The Health and Safety Authority – HSA
4.10pm - 4.30pm	<i>Magneto-responsive polymer micelles based on Iron Oxide Nanoparticles and Diblock Copolymers with β-Ketoester Functionalities: Fabrication, characterization and in vitro Biocompatibility</i> Theodora Krasia-Christoforou University of Cyprus
4.30pm - 4.50pm	<i>A cell cycle study on the nanoparticle-cell dialogue</i> Jong-ah Kim Centre for BioNano Interactions, UCD
4.50pm - 5.10pm	<i>In vitro mammalian cytotoxicological study of PAMAM dendrimers – towards quantitative structure activity relationships</i> Sourav Mukherjee Focas Institute, DIT
6.00pm - 7.00pm	Prosecco Reception
7.00pm – 9.00pm	Dinner

Programme Friday 16th October

WELCOME

9.15am - 9.30am **Welcome - Chantal Durant**
European Science Foundation

NANOMEDICINE

9.30am – 12.50pm **Session 3 Oral Presentations: NanoMedicine**
Chairs: Chantal Durant and Markus Linder

9.30am - 10.00am *Nanotechnology Health and Medicine*

Ruth Duncan
Cardiff University

10.00am - 10.20am *Inspiring BioNanoMed*

Marek Radomski
CRANN, TCD

10.20am - 10.40am *Potential development of amyloid-based biomedical adhesives*

Anika Moestart
Conway Institute, UCD

10.40am - 11.00am *Surface Charge in Biomedical Devices*

Tofail Syed
MSSI, UL

11.00am - 11.30am **Coffee and Poster Session**

11.30am - 11.50am *NanoMechanical Diagnostics*

Martin Hegner
CRANN, TCD

11.50am - 12.10pm *BioInspired NanoSystems for Gene and Drug Delivery*

Joachim Radler
Ludwig Maximilians-University Munich

12.10pm - 12.30pm *Nanoscale Temperature Responsive Culture Surfaces for
Cell Culture and Recovery*

Maria Nash
National Centre for Biomedical Engineering Science, NUI Galway

12.30pm - 12.50pm *Antibody Targeting of Polymeric Nanoparticles for Cancer Therapy*

Chris J. Scott
Queens University Belfast

12.50pm - 2.00pm **Lunch - Poster Session & Trade Stand**

NANOGREEN

2.00pm - 5.00pm **Session 4 Oral Presentations: Green Nanotechnology**
Chair: Kenneth Dawson

2.30pm - 3.00pm *Nanochemistry for photovoltaic's*

Denis Fichou
Centre National de la Recherche Scientific

3.00pm - 3.20pm *The use of nanoparticles for concentrating diffuse solar radiation*

Sarah McCormack
Dept of Civil, Structural and Environmental Engineering, TCD

3.20pm - 3.50pm **Coffee and Poster Session**

3.50pm - 4.10pm *Organic Polymers for Green Energy and Sensor Technologies*

Joe O'Mahony
School of Engineering, Waterford Institute of Technology

4.10pm - 4.30pm *Green Photocatalytic Synthesis of Stable Au and Ag Nanoparticles*

Eulália Pereira
REQUIMTE, Universidade do Porto

4.30pm - 4.50pm *Engineered proteins for bionanomaterials*

Markus Linder
VTT Business from Technology

4.50pm – 5.00pm Close and Poster Prizes