KATHOLIEKE UNIVERSITEIT
LEUVEN

Capita Selecta Lectures of Nanoscience and Nanotechnology H6L3 & H6N2

Prof.dr.ir. Jo De Boeck
K.U.Leuven, Belgium

Imec, Kapeldreef 75,
B-3001 Leuven, Belgium

Program and Abstracts

Academic Year 2013-2014

Introduction

How does so-called Nanoscience and Nanotechnology impact on modern society?
What are important scientific and technological nanotech fields at present?
What novel properties are created by precise manipulation of materials at atomic scale?
Can we construct novel building blocks with nano-scale precision and for what purpose?
What is the link between nanotech and life science?
What are there ethical or legal aspects we should know and care about?
What business opportunities arise in e.g. life-science, biotech, ICT or consumer products?

In the academic year 2013-2014, the 8th edition, Capita Selecta Lectures of Nanoscience and Nanotechnology[1], comprises of 13 lectures that will address a.o. the above questions. The lecturers are local and international experts on the selected topics, of which you can find the program details in this brochure. The topics are selected with input from the Erasmus Mundus program partners[2] and input from the students.

The topics and dates and location of the 2013-2014 lectures are as follows:

11-Feb	Kloosterman Fabian	NERF	Functional and structural organization of brain circuits: memory during behaviour
18-Feb	Baraban Larysa	TUDresden	Artificial nanomachines
25-Feb	Ryckaert Vincent	imec	Use of Intellectual Property in Nanoscience and Nanotechnology
4-Mar	Bylander Jonas	Chalmers	Quantum mechanical engineering of electronic circuits
11-Mar	Rudquist Per	Chalmers	Liquid crystals
18-Mar	Kas Koen	Thrombogenics	Morphing a few guardian angels to disrupt healthcare, and enjoy iT
25-Mar	Arcizet Oliver	Neel Inst.	Nano-optomecanics
1-Apr	Thielemans Wim	Kortrijk/KUL	Nanomaterials based on Cellulose Nanowhiskers
22-Apr	Vandersypen Lieven	DELFT	From quantum surprises to quantum devices
29-Apr	Artero Vincent	CEA-iRTSV-LCBM	Hydrogen and artificial photosynthesis: from micro-organisms to catalytic nanomaterials
6-May	Bakkers Erik	TUEindhoven	Semiconducting Nanowires
13-May	Doornbos Gerben	TSMC	The struggling relationship between nanotechnology and semiconductor industry
20-May	Gutierrez Rafael	TUDresden	Unconventional Computing

[1]These lectures are organized in the frame of the Courses H6L3 "Capita Selecta of Nanoscience and Nanotechnology" within the Master of Nanoscience and Nanotechnology at the K.U.Leuven and H6N2 "Erasmus Mundus Lectures on Nanoscience and Nanotechnology".
[2]K.U.Leuven, TU Dresden, Chalmers University and the Université Jean Fourrier Grenoble.

All lectures are broadcast live by the Audio-Visual department of the K.U. Leuven (AVNet) to all Erasmus Mundus partner universities using a Virtual Classroom concept. The lectures are open to everyone interested in the field and compulsory for the students in both Master programs[3]. All lectures are always followed by a discussion session involving the lecturers, the students and nanotechnology professionals.

We look forward to welcome you at the Capita Selecta Lectures.

Prof. Jo De Boeck, Coordinator H6L3/H6N2
December, 2014.

[3] Students have to follow at least 20 lectures in 2 consecutive years and to produce a report each year.

Capita Selecta of Nanoscience and Nanotechnology

Program, Abstracts and CV's

Program

Tuesday, 11 February 2014, 5-7pm (Broadcast from Leuven, Aud. "De Molen")
Prof. Fabian Kloosterman, NERF, imec, Belgium
Functional and structural organization of brain circuits: memory during behaviour

Tuesday, 18 February 2014, 5-7pm (Broadcast from Dresden)
Dr. Larysa Baraban, T.U.Dresden, Germany
Artificial nanomachines

Tuesday,25 February 2014, 5-7pm (Broadcast from Leuven, Aud. "De Molen")
Dr. Vincen Reyckaert, imec, Belgium
Use of Intellectual Property in Nanoscience and Nanotechnology

Tuesday, 4 March 2014, 5-7pm *(Broadcast from Chalmers)*
Jonas Bylander, Chalmers University of technology, Göteborg, Sweden
Quantum mechanical engineering of electronic circuits

Tuesday, 11 March 2014, 5-7pm *(Broadcast from Chalmers)*
Per Rudquist, Chalmers University of technology, Göteborg, Sweden
Liquid crystals

Tuesday, 18 March 2014, 5-7pm (Broadcast from Leuven, Aud. "De Molen")
Kas Koen, Thrombogenics, Belgium
Morphing a few guardian angels to disrupt healthcare, and enjoy iT

Tuesday, 25 March 2014, 5-7pm (Broadcast from Grenoble)
Arcizet Olivier, Inst. Neel, France.
Nano-optomecanics

Tuesday, 1 April 2014, 5-7pm (Broadcast from Leuven, Aud. "De Molen")
Wim Thielemans, KUL/Kortrijk, Belgium
Nanomaterials based on Cellulose Nanowhiskers

Tuesday, 22 April 2014, 5-7pm (Broadcast from Leuven, Aud. "De Molen")
Lieven Vandersypen, Delft, The Netherlands
From quantum surprises to quantum devices

Tuesday, 29 April 2014, 5-7pm (Broadcast from Grenoble)
Vincent Artero, CEA-iRTSV-LCBM
Hydrogen and artificial photosynthesis: from micro-organisms to catalytic nanomaterials

Tuesday, 6 May 2014, 5-7pm (Broadcast from Leuven, Aud. "De Molen")
Erik Bakkers, TUEindhoven, The Netherlands
Semiconducting Nanowires

Tuesday, 13 May 2014, 5-7pm (Broadcast from Leuven, Aud. "De Molen")
Gerben Doornbos, TSMC, Belgium
The struggling relationship between nanotechnology and semiconductor industry

Tuesday, 20 May 2014, 5-7pm (Broadcast from Dresden)
Rafael Guttierrez, TUDresden, Germany
Unconventional Computing

Capita Selecta of Nanoscience and Nanotechnology

Abstracts & CV's

Tuesday, February 11, 2014, 5-7pm
Fabian Kloosterman, Imec, NERF, Belgium

Functional and structural organization of brain circuits for spatial memory and navigation

The brain is an intricate machine in which billions of neurons are interconnected in extensive networks. Dynamically coordinated activity patterns in these networks perform computations that support complex behaviors. In this lecture, I will present the structure and function of a brain network that supports spatial memory and navigation. In particular, I will discuss 1) the tools and techniques for monitoring the activity of large numbers of neurons in behaving organisms and 2) what such population activity can tell us about how our daily experiences and memories are represented in the brain.

Prof. Fabian Kloosterman

Fabian Kloosterman *received in his MSc degree in medical biology and his PhD degree in neurobiology at the University of Amsterdam in the Netherlands. From 2003 to 2011, he worked as a postdoctoral researcher and research associate in the Picower Institute for Learning and Memory at the Massachusetts Institute of Technology in the USA. At the end of 2011, Dr. Kloosterman became the third principal investigator at the NeuroElectronics Research Flanders – a basic brain research initiative founded by imec, VIB and KU Leuven. He is also a part-time professor in the department of Biological Psychology at KU Leuven.*

Tuesday, February 18, 2014, 5-7pm
Larysa Baraban, Max Bergmann Centre of Biomaterials, Dresden University of Technology, Germany

Artificial nanomachines

Among the family of man-made engines, self-propelled catalytic motors capable to transform chemical energy into mechanical power are one of the most dynamically developing classes of synthetic machines. State-of-the-art catalytic motors are decorated with a catalyst that triggers the decomposition of hydrogen peroxide into water and oxygen. Here, we demonstrate the *spherical* catalytic Janus motors2,3 in context of their potential *in-vitro* and *in-vivo* applications in field of targeted drug delivery, bio detection, or shuttle transport of living cells.
Firstly, we show that catalytically active Janus micro-spheres are capable of autonomous motion and can act as carriers for transportation of cargo at the micron-scale. Complex dynamics exhibited by Janus motors is studied for the cases of single or a pair of Janus Finally, we address for the first time the directional control of the spherical motors via combining their catalytic and magnetic cap structures. The specific magnetic properties of the Janus motors are provided by ultra-thin multilayer films that are designed to align the magnetic moment along the main symmetry axis of the cap. This unique property allows a deterministic motion of the Janus particles when guided in an external magnetic field. We demonstrate this capability by applying them for manipulation (uploading, transportation, delivery) and sorting of micro objects on microfluidic chips.
The observed directional control of the motion combined with extensive functionality of the colloidal Janus motors conceptually opens a straightforward route for targeted delivery of species, which are relevant in the field of chemistry, biology, and medicine.

Dr. Larysa Baraban

Larysa Baraban *studied Physics at the Taras Shevchenko National University of Kyiv (Ukraine) from 1999 to 2005. She got there her Master of Science degree on the "Calculation of optical properties of the thin films" with Prof. Valeri Lozovski. For her PhD she joined the group of Prof. Paul Leiderer at the University of Constance. There she worked on the systems of magnetic colloidal particles for the modelling of the condensed matter phenomena. In January 2009, after defending her PhD thesis, she joined the group of Prof. Jerome Bibette at the Ecole superieure de Physique et de Chimie Industrielles de la Ville de Paris as a Post Doc. There she was working on the development of an innovative millifluidic platform for microbiological assays. In February 2011 she moved to the Leibniz Institute for Solid State and Materials Research Dresden (director Prof. Oliver Schmidt), where she worked on the integration of magneto-resistive sensors into microfluidic lab-on-a-chip systems for biodetection. In October 2011 she started her work in the group of Prof. Cuniberti. Here she plans to work on the development of silicon nanowires based biosensors with "InnovaSens" group*.

Tuesday, February 25, 2014, 5-7pm
Vincent Ryckaert, IP Business intelligence
Imec, Belgium

Use of IP in Nanoscience and Nanotechnology

While IP tends to be perceived by Academia as hampering innovation, the lecture will demonstrate the entire opposite, in that IP, if well understood and creatively applied, is an essential and positive tool, to traverse the R&D life cycle, from idea to market. Various aspect of IP will be touched upon and illustrated with real-life examples and casted in present trends in IP.

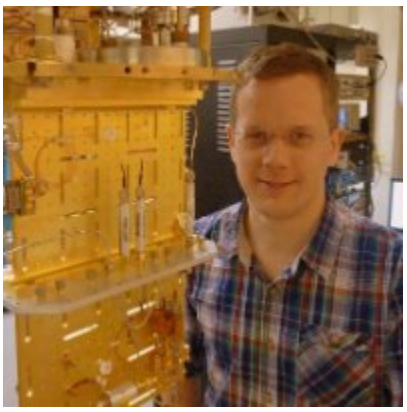
Dr. Vincent Ryckaert

Vincent Ryckaert *received his Civil Engineer Degree and his PhD Degree in Applied Science for his work in Industrial Automation at University of Leuven. Vincent joined IMEC's patent group within IMEC Business Development, and was mainly assigned to patent applications in the field of Electronic Design Automation, Telecommunication and Multimedia. He became head of the IPAI (Intellectual Property for Ambient Intelligence) section of the patent group. Vincent qualified as European Patent Attorney. He also has followed in-depth training in US Patent, Licensing Law and further developed in-depth expertise in the field of so-called software enabled patents both in accordance with EPO and USPTO practices. He received his diploma on Litigation of European Patents from the University Robert Schuman, Strasbourg, Center for Intellectual Property Studies. Since 2009 his efforts at IMEC are directed towards IP business and intelligence work and therefore further specializes in topics as IP Due Diligence, Patent Opinions and strategies, arbitration, role of IP experts in business disputes. He got an extra qualification to act as court expert and followed training in arbitration and offers since 2011 also free-lance consultancy services thereon via his own TIPEAS BVBA.*

Tuesday, March 4, 2014, 5-7pm
Jonas Bylander, Chalmers University of Technology, Göteborg, Sweden

Quantum mechanical engineering of electronic circuits

By engineering low-loss and non-linear electrical circuit elements on a microchip, we can make the whole circuit behave quantum mechanically. This means that macroscopic variables, such as the charge on a capacitor or the current around a loop of wire, can have quantum fluctuations; consequently, our knowledge of their values is limited by Heisenberg's uncertainty principle. We can take advantage of this feature to make devices that work according to different principles than conventional electronics and photonics, and to study fundamental quantum physics. I will introduce some quantum mechanical electric and microwave-photonic circuits and present examples of the state of the art in this field.



Dr. Jonas Bylander

Jonas Bylander received his M.S. degree in Engineering Physics in 2002, and his Ph.D. in Physics in 2007, both from Chalmers University of Technology in Gothenburg. For his undergraduate thesis he worked at a French CNRS laboratory outside of Paris, where he studied the emission of single photons from semiconductor quantum dots. This work aroused his interest in nanotechnology and the engineering of quantum-mechanical systems. He then did his Ph.D. in mesoscopic physics – the realm in-between the small scale of atoms and the large scale of our everyday world – and he succeeded in measuring an electrical current by counting its constituent single electrons one by one. For his postdoc, Jonas went to MIT to study quantum coherence in superconducting quantum circuits. The quantum-mechanical properties – so-called "quantum coherence" – of such devices are fragile and sensitive to noise. Jonas characterized this noise and developed techniques to moderate the loss of "quantumness." For a while he held the record for the world's longest coherence time in a superconducting qubit. Since 2013, Jonas is an assistant professor at Chalmers, where he studies the quantum coherence in superconducting electrical devices, and quantum charge transport in nanostructures.

Tuesday, March 11, 2014, 5-7pm
Per Rudquist, Microtechnology and Nanoscience, BioNano Sytems Laboratory, Chalmers University of Technology, Sweden

Liquid Crystals

Liquid crystals constitute an important class of soft matter and even very weak perturbations may influence their structure and properties. They are composed of self-assembling organic anisometric molecules and represent a considerable number of different well-defined types of long range order the physics of which has more resemblance to solid state features than to common liquids.
For most people liquid crystals are synonymous to liquid crystal displays (LCDs) for TV, computers, mobile phones, and surf pads, and the enormous success of liquid crystal display technology sometimes overshadows modern liquid crystal research, the results from which are often also relevant for other research fields.
In this lecture I will describe the basics of liquid crystals and how these materials are used in e.g. LCDs. I will also discuss recent research on ferroelectric and antiferroelectric LCs, providing much faster switching than conventional (nematic) LCs, and give several examples of liquid crystals in nanoscience.

Assoc. Prof. Per Rudquist

Per Rudquist received his Master of Science in Engineering Physics in 1992 and his PhD degree in 1997 from Chalmers University of Technology. He is today Associate Professor in the BioNanosystems Laboratory at the department of Microtechnology and Nanoscience at Chalmers. He has spent several research periods at University of Colorado at Boulder, USA, and was during 2004-2012 on the Board of Directors for the International Liquid Crystal Society. His research interests include physics and device physics of chiral liquid crystals, with focus on optics, electrooptic effects, and applications. He is also co-founder of the company Orthocone Innovation Technologies AB, Göteborg, Sweden, developing orthoconic antiferroelectric liquid crystals and applications.

Tuesday, March 18, 2014, 5-7pm
Koen Kas, Thrombogenics, Leuven, Belgium

Morphing a few guardian angels to disrupt healthcare, and enjoying iT

Introducing three guardian angels, this talk takes us on a tour to the future of healthcare.
Combining different layers of our biological code (in reading and writing mode), quantified data from visible and invisible sensors, and the connected Internet of Things will indeed open up unseen opportunities for the way we deal with ourselves in health and disease. Together with attractive design, appropriate use of different (nano)technologies will convert us into health consumers, with our doctors as consultants.
This will move us away from current curative healthcare to personalized, preventive and even augmented healthcare.

Prof. Koen Kas

***Koen Kas** is a biotech entrepreneur with more than 20 years of experience in the life sciences.*
He is founding CEO of InBioVeritas, trendspotting developments at the crossroads of biology, genomic medicine, ICT, social media and the Internet of Things. He uses these insights in different advisory roles facilitating innovative disruptions in healthcare and is working on a book around this topic.
He is the Chief Scientific Officer Oncology of Thrombogenics, a biopharmaceutical company focused on developing innovative medicines for ophthalmic and oncology applications.
Koen was founding CEO & CSO of Pronota, a company committed to better diagnosis and personalized medicine in the areas of ovarian cancer, preeclampsia, cardio-renal failure & sepsis. He was, prior to that Director drug discovery at Galapagos. Previously, he set up and directed the Cancer drug discovery program at Tibotec (now Johnson & Johnson).
Koen is guest professor at Ghent University, Belgium, and chairs the scientific committee of the European Cancer Prevention Organisation.
He received his MSc., cum laude, in Biology/Biotechnology in 1989 and his PhD degree in Biomedical Sciences from the University of Antwerp where he also obtained a degree in Business Administration. After his postdoctoral research at the Center of Human Genetics, University of Leuven, Belgium, he became a group leader of the Flanders Interuniversity Institute for Biotechnology. In 1999 he was appointed professor at the University of Leuven, Belgium and lecturer at Harvard University, Boston, USA. His major scientific contributions during his academic life were the unraveling of the molecular basis of salivary gland and hereditary endocrine tumors. Dr. Kas is author of over 60 publications in international journals in the field of cancer, biomarkers, human genomics and proteomics. He authored over 20 patents and patent applications. He is a member of different scientific societies and received prestigious awards from NATO and the Collen Research Foundation and from the Royal Belgian Academy of Sciences and the Belgian Royal Academy of Medicine.

Tuesday, March 25, 2014, 5-7pm
Olivier Arcizet, Néel Institute, CNRS, Grenoble

Nano-optomecanics

This lecture will introduce the field of optomechanics, exploring the fundamental coupling between an optical field and a mechanical degree of freedom. We will introduce the concept of measurement back action and the quantum limits of ultrasensitive displacement sensing. Then we will describe the different strategies developed to go beyond the diffraction limit and introduce the field of nanomechanics and its recent developments.

Dr. Olivier Arcizet

Olivier Arcizet *obtained his PhD in Laboratoire Kastler Brossel, under the supervision of A. Heidmann on ultrasensitive readout and laser cooling of micro-mechanical oscillators. He worked as a postdoc in T. Kippenberg group at Max Planck Institute for Quantum Optics in Garching, studying ultrahigh Q microcavities and joined Institut Néel as a CNRS researcher in 2009. Since then he has been pursuing research activities in Nano-Optomechanics and Hybrid Nanomechanical systems.*

Tuesday, April 1, 2014, 5-7pm
Wim Thielemans, K.U.Leuven, Belgium

Nanomaterials based on cellulose nanowhiskers

Humanity is under increased pressure to reduce energy consumption, reduce waste disposal and increase the use of renewable materials. The development of functional nanomaterials based renewable resources has the potential to deliver a holistic solution by increasing activity, reducing the use of depletable resources, reduction in CO_2 emissions, and reducing the waste at end-of-life. In our group we are developing a renewable nanoparticle technology platform based on cellulose nanowhiskers, rigid-rod like single-crystal nanoparticles derived from native cellulose. We investigate a range of surface functionalisation pathways such as introduction of ionic groups and pH-sensitive fluorophores as well as surface-initiated polymerisation, and metal nanoparticle immobilisation. In addition, we also study their self-assembly into higher order structures such as membranes, hydrogels and aerogels. The combination of virtually unlimited surface functionality which can be introduced with our expertise in nanoparticle self-assembly enables the design and manufacture of highly functional structures with applications in for example separations, ad/absorption materials, and catalysis.

Prof.dr.ir. Wim Thielemans

Wim Thielemans *received his chemical engineering degree in 1999 from the University of Leuven (Belgium) and his PhD in Chemical Engineering in 2004 from the University of Delaware (Newark, DE, USA) . He then spent 2 years as a Marie Curie research fellow at the National Polytechnic Institute of Grenoble (France). In 2006 he moved to the University of Nottingham (Nottingham, UK) to set up his own research group where he was jointly appointed by the School of Chemistry and the Department of Chemical and Environmental Engineering under the Driving Innovation in Chemistry and Engineering (DICE) programme. In 2013, he moved back to the University of Leuven under the Odysseus programme to continue his independent career.*
In his research Wim has been leading work on the surface modification, self-assembly and advanced materials manufacturing of cellulose, starch and chitin nanoparticles.
Wim is a member of the Royal Society of Chemistry and sits on the scientific advisory board of the journal Industrial Crops and Products (Elsevier). He has over 60 publications and 1 patent and has an h-index of 19. In 2007, he won the Silver Award for his research in 2007 at the UK House of Commons Set for Britain event, and in 2008, received the Green Chemistry Prize for Innovative Science at the Gordon Research Conference for Green Chemistry. He has also held a 2011 Science Communication Fellowship from Advancing Green Chemistry and Environmental Health Sciences and has been a visiting professor to the University of Rouen (France) and a visiting scientist to Unilever R&D (Vlaardingen, The Netherlands).

Tuesday, April 22, 2014, 5-7pm
Lieven Vandersypen, Kavli Institute of Nanoscience,
TU Delft, The Netherlands

From quantum surprises to quantum devices

One of the most radical consequences of creating devices at the nanoscale is that quantum mechanical behavior can become apparent. This enables completely new technologies based on quantum principles, from quantum computers to quantum sensors and quantum cryptography. In this lecture, I will summarize the basic concepts behind this new technology, and give an overview of the state-of-the-art in nanoscale approaches to quantum technology.

Prof. Lieven Vandersypen

Lieven Vandersypen *(Leuven, 1972) is Antonie van Leeuwenhoek Professor at the Kavli Institute of Nanoscience at TU Delft. He studied Mechanical Engineering at the KU Leuven and received a PhD in Electrical Engineering from Stanford University (2001), for work on NMR quantum computing. In Delft, he works on quantum computers based on electron spins in quantum dots, and on mesoscopic devices in graphene. He received a ERC Starting Grant (2007), and recently and ERC Synergy Grant, together with his colleagues, for research in solid-state quantum computing.*

Tuesday, April 29, 2014, 5-7pm
Vincent Artero, Université de Grenoble et
CEA/Life Science Division, France

Hydrogen and artificial photosynthesis: from micro-organisms to catalytic nanomaterials

As far as hydrogen/water interconversion is concerned, a number of technological solutions such as those developed in proton-exchange-membrane fuel-cells or electrolyzers are based on the powerful catalytic properties of platinum metal. But this scarce and expensive metal itself is not a sustainable resource and its replacement by low cost and readily available materials is a requisite for these technologies to become economically viable. A competitive alternative to platinum could be found in living micro-organisms metabolizing hydrogen thanks to hydrogenases. Catalysis in hydrogenases only requires base-metal centers (nickel and iron) and their active sites can be used as an inspiration to prepare new synthetic catalysts for hydrogen production that can be further grafted on nanostructured materials.
In addition, it is highly desirable to produce hydrogen from renewable resources such as water and solar energy as done by some natural micro-organisms thought a photosynthetic process. To work towards this end, we will show how we can take inspiration from microbes and algae to design noble-metal free photocatalytic systems, immobilize them on nanostructured electrode materials and implemented into Photo-Electrochemical cells.

Dr. Vincent Artero

Vincent Artero *(born 1973) joined the laboratory of Chemistry and Biology of Metals (CEA-Grenoble) in 2002. He is a former student of the Ecole Normale Supérieure (graduated with agrégation in Chemistry) and got his PhD from Univ. Paris VI (Anna Proust's group) on polyoxometallate chemistry. After a postdoc in Pr. Ulrich Kölle's team at Aachen, Germany, he joined the CEA-Grenoble where he focused on the design of electro- and photocatalytic systems for hydrogen production and artificial photosynthesis.*
He is the author of about 55 publications and his team is currently recognized in the field at the international level. He received in 2011 the Grand Prix Mergier-Bourdeix from the French Academy of Sciences and won in 2012 an ERC Starting Grant on artificial photosynthesis for the production of solar fuels. He is the vice chair of the European COST ACTION CM1202 focusing on supramolecular systems for water splitting.

Tuesday, May 6, 2014, 5-7pm
Erik Bakkers, Delft Technical University, The Netherlands

Semiconducting Nanowires

Semiconducting Nanowires represent a novel materials system with a broad variety of possible applications ranging from renewable energy (solar cells, thermoelectrics), optical devices (LEDs, lasers), electronics (FETs), to a platform for the search of new particles like the Majorana fermion. This nanowire system is unique because 1) it is facilitates to make materials combinations, which have never been possible before, 2) well-known semiconductors can be grown with a different crystal structure, which have new properties. These features give new knobs to tweak the opto-electronic properties. In this lecture the growth mechanism, device fabrication and optical properties of nanowires will be discussed.

Prof. Erik Bakkers

Erik Bakkers obtained his MsC (1996) and PhD (2000) degree in Chemistry at the Utrecht University. Directly after his PhD he started at Philips Research labs in Eindhoven and has initiated the work on nanowires. Since 2010 Erik is affiliated as full professor at the Eindhoven and Delft Technical Universities.

Tuesday, May 13, 2014, 5-7pm
Gerben Doornbos, TSMC, Belgium

The struggling relationship between nanotechnology and semiconductor industry

No business has benefitted from developments in nanotechnology more than the semiconductor industry. Over the last three decades we have witnessed nothing less than a revolution in the usage of microprocessors in everyday products, especially in mobile applications, which has undoubtedly changed our society. This has been facilitated by the continuous strive for smaller transistors, however with dimensions now well within the nanometric range the chip industry faces serious challenges to maintain the pace. Using transistor scaling as historical background I will discuss those challenges, and I will explain why it is so difficult for the industry to adopt novel nanotechnological developments which at first glance seem to solve all issues. Finally, by explaining how the industry is organized I will try to provide guidelines for a more seamless acceptance of innovations, *i.e.* on how you can help to make my work easier.

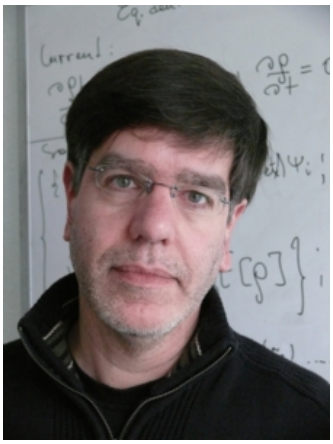
Dr. Gerben Doornbos

Gerben Doornbos *was born in 1969 in The Netherlands. He received his PhD degree in physics from the Vrije Universiteit Amsterdam (VU) in 2001 for an experimental study of the dynamic behavior of magnetic vortices in Type-II superconductors. He became aware the great potential of numerical simulation in 1999-2000 when he worked in the VU physics-applied computer science group, applying massively distributed computing to complex physics-based problems.*
Gerben joined Philips Research (which transitioned to NXP Semiconductors in 2006) in Leuven, Belgium, in 2000, working on the simulation of advanced CMOS and high-voltage electronics. Since 2009 he is with TSMC, where he is responsible for the modeling of advanced transistor concepts with the ultimate goal to assess their potential for application, currently focusing on 7nm and beyond technologies.

Tuesday, May 20, 2014, 5-7pm
Rafael Gutierrez, Dresden University of Technology, Dresden, Germany

Unconventional Computing

Most of the current research in nanoelectronics can be related to one of two lines: a) attempts to transpose the principles of traditional electronics into new technological scenarios and b) searching for innovative solutions tailored on the nanoscale properties of matter. The second approach has the merit of looking for a closer linking between the physics of devices and the computational paradigms implemented. This presentation will outline ongoing efforts for two cases related to the strategy b): the development and use of networks of nanoscale components for unconventional information processing and the development of molecular based Quantum-dot Cellular Automata (m-QCA).



Dr. Rafael Gutierrez

Dr. Rafael Gutierrez *received his Ph.D. degree in Physics in 1995 from the Dresden University of Technology. He worked as a Post-Doctoral Researcher at the Universities of Chemnitz, Freiberg, and Regensburg. Topics of his research cover the electronic and charge transport properties of nanoscale materials. He is currently leading the research group Bioelectronics and Neuromorphic Materials at the Chair for Materials Science and Nanotechnology at the Dresden University of Technology*.