Metrology

B. Capraro
Research Manager, Silicon Technology
Intel Research and Development Ireland Ltd,
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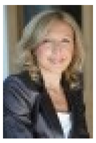
Biography
Bernie received a Masters Degree in Engineering (MEng) from Newcastle upon Tyne Polytechnic (now University of Northumberland) and has been working at Intel for the past 21 years holding various Engineering and Management roles across the wafer fabrication facilities. Bernie is currently responsible for all silicon nanotechnology research involving Intel Ireland, helping to deliver potential solutions to Intel for materials, devices, equipment and processing techniques required for the future technology nodes in collaboration with Research Centres, Academia and Industry across Ireland and Europe. Bernie’s semiconductor career spans 31 years, with other Process and Equipment Engineering positions held at Telefunken GmbH (Ge), Nortel/Bell Northern Research (UK/Canada), Applied Materials (UK) and Newport Wafer Fab (UK). In addition, Bernie is instrumental is developing Intel Ireland's relationships with third level Education Institutions, working on Policy, Talent pipeline and Research initiatives.

Advanced imaging of novel low-dimensional nanostructures



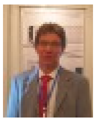
V. Nicolosi
Professor of Nanomaterials and Advanced Microscopy
Trinity College Dublin, Chemistry & CRANN,
Dublin, Ireland

Abstract
Low-dimensional nanostructured materials such as organic and inorganic nanotubes, nanowires and platelets are potentially useful in a number of areas of nanoscience and nanotechnology due to their remarkable mechanical, electrical and thermal properties. However, difficulties associated with their lack of processability have seriously hampered both. In the last few years dispersion and exfoliation methods have been developed and demonstrated to apply universally to 1D and 2D nanostructures of very diverse nature, offering a practical means of processing the nanostructures for a wide range of innovative technologies. To make real applications truly feasible, however, it is crucial to fully characterize the nanostructures on the atomic scale and correlate this information with their physical and chemical properties. Advances in aberration-corrected optics in electron microscopy have revolutionised the way to characterise nano-materials, opening new frontiers for materials science. With the recent advances in nanostructure processability, electron microscopes are now revealing the structure of the individual components of nanomaterials, atom by atom. Here we will present an overview of very different low-dimensional materials issues, showing what aberration-corrected

electron microscopy can do for materials scientists.

Biography
Prof. Nicolosi received a BSc in Chemistry from the University of Catania (Italy) in 2001 and a Ph.D. in Physics in 2006 from Trinity College Dublin.
In 2008 she moved to the University of Oxford as a lecturer and in 2012 she returned to Trinity College Dublin as Research Professor.
Today she is the Chair of Nanomaterials and Advanced Microscopy in Trinity College Dublin, and a PI in the SFI Centres AMBER and I-Form.
She is the first woman to have reached the position of Chair in the School of Chemistry since the foundation of Trinity College Dublin in 1592.
She has published more than 200 high-impact-papers, including Science, Nature, Nature Nanotechnology, Nature Materials amongst the others, and delivered more than 100 invited and plenary presentations at major conferences/institutions/public events.
Over the years she has won numerous awards: the RDS/Intel Prize for Nanoscience 2012, the World Economic Forum Young Scientist 2013, EU Woman in Technology Award 2013, SFI President of Ireland Young Researcher Award 2014, SFI Irish Early Stage Researcher 2016, TCD ERC Awardee 2017, Women Business Forum Women of the Decade in Science & Innovation 2018.
Prof. Nicolosi is the only 5 times ERC awardee in Europe: she received a €1.5m Starting Grant in 2011, followed by 3 Proof-of-Concept top-up grants to bring results of frontier research closer to the market, and a €2.5m Consolidator Grant in 2016. This brings her total research funding awarded in the past 5 years to over €15 million.
Her research has found direct commercial impact, being licenced to companies like Samsung Korea, Nokia, LEGO and Ferrari Formula 1.
In several occasions she has accompanied the President of the European Research Council, Prof. Jean-Pierre Bourguignon, to high level meetings at the European Parliament and with the government of Ireland, where she further demonstrated her pioneering work and her commitment to the future of research.
The European Parliament Commissioner for Research, Science and Innovadion, Carlos MOEDAS, chose her to accompany him at a press conference called to celebrate the ERC 10th anniversary at the headquarters of the European Commission in March 2017.
On the 9th of November 2017 she gave a keynote speech at the Falling Walls Conference in Berlin. This remarkably prestigious conference celebrates this historic event focusing on the future walls to fall in science and society. German Chancellor Angela Merkel, the German Federal President and distinguished international government representatives have keynoted the past conferences. “The brightest minds on the planet” meet at the Falling Walls Conference, BBC London stated and according to the New York Times it is „the most exceptional science conference in the world“.

Establishing smart plasma process control in production lines



T. Schütte
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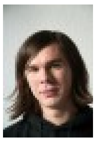
PLASUS
Spectroscopic plasma monitor and process control systems

Abstract
While metrology tools are getting more advanced and providing plenty of valuable data of process and product, there is still a lack in evaluating and combining these information for an integral process analysis and real-time control. In plasma processing optical emission spectroscopy is well known and often established as a process monitor by observing a single emission line e.g. to detect an endpoint or to survey the process stability. However, using the spectroscopic plasma monitoring technique all acquired spectroscopic data is evaluated simultaneously and in real-time and thus, provides a more comprehensive insight in the plasma chemistry, the composition of the plasma and its temporal evolution. Combing the spectroscopic plasma monitoring data with other real-time plasma metrology data will complete the picture of the plasma process. In order to scope with the more complex and advanced processes for next generation products it is essential to interconnect the metrology tools and its data and data analysis as it is addressed by IoT or Industry 4.0. In an example from solar cell production the benefits of the advanced spectroscopic plasma monitoring technique are illustrated and the advantages of combining metrology tools are outlined.

Biography
Dr.-Ing. Thomas Schütte studied Electrical Engineering at the Technical University Munich and the University of Southern California in Los Angeles and received his Diploma and MSEE, respectively. During his PhD at the University Stuttgart he specialized in plasma physics and plasma spectroscopy and in 1996 he established the company PLASUS where he acts as CEO and technical director of PLASUS GmbH now. He was and still is dedicated to develop and realize plasma monitor and process control systems for production lines for all types of plasma applications.

One-Shot, nm-precise metrology for in-line applications



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Abstract

The manufacturing of power chip technologies, semiconductors and thin-film structures demand quality, precision and reliability regarding the manufacturing processes. Therefore, appropriate in-line ready, integrated and fast characterization methods are required. One of the key requirements for such a system is the ability to gather e.g. precise topography data without the need of mechanically moving parts in order to ensure a fast data acquisition and minimal uncertainties.

Within this work an alternative approach based on a white-light interferometer is presented which is designed to comply with these requirements. The interferometer is equipped with a supercontinuum white-light source and defined dispersion over the given spectral range. Due to the known dispersion characteristics, it becomes possible to calculate the surface profile with nm-precision from the phase-varied spectral data. In a two-dimensional approach the surface profile is encoded in one dimension as spectral modulations (z-coordinate) while the second dimension holds information about the spatial distribution of the profile (y-coordinate). The talk explains the data analysis model, calculations of theoretical resolution as well as the experimental setup and its results. Experimental results are presented from samples such as a precision height standard, Si-wafers, MEMS pressure sensors and spin-coated polymer layers. It could be shown that the resolution in the z-coordinate during the experiments was in the order of 2 nm while the resolution in the y-coordinate was in the range of 5 µm. The results of the interferometric measurements where furthermore evaluated with other techniques such as a confocal scanning microscope. Additionally experiments under varying temperature conditions proved a high stability with only 0.15 nm/K drifts.

The interferometric method has advantages in fast, in-line metrology applications as it has shown high accuracy and robustness during different experiments.

Biography

My name is Christopher Taudt. I`ve received a Bachelor’s degree in Mechanical Engineering from the Institute of Technology Sligo, Ireland as well as a diploma degree in Mechanical Engineering from the University of Applied Sciences Zwickau, Germany. Furthermore, I successfully completed a research period in the USA (University of Pittsburgh) and did freelance work in programming for the automotive industry. Currently I’m a PhD student at the University of Applied Sciences Zwickau and the Technical University Dresden, Germany. Additionally, I`m a team manager at the Fraunhofer Application Center for Optical Metrology and Surface Technologies in Zwickau, Germany.

My main working area is optical metrology, especially low-coherence interferometry. In this research area I’m mainly interested in the characterization of materials such as semiconductors and polymers during the different processing steps. This can include topographic, optical and other properties of the aforementioned materials. One of the most important aspects in my research is the strong cooperation with industrials partners in national and international projects.

Predictive Probing: A novel approach to minimize efforts at final test

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Abstract

Quality control plays a crucial role in the manufacturing of premium products. Measures for quality control are implemented, on the one hand, right after crucial process steps to ensure single process quality. On the other hand, the application of sophisticated test procedures during final test guarantees high quality of the final product.

For instance, in LED manufacturing, high effort is spent to probe every single LED chip: in dedicated probing equipment, ultra-thin needles are used to contact an LED and measure its brightness, color and electrical properties. With thousands of LED chips to be tested per wafer, this is a time-consuming and expensive step.

Predictive probing aims at significantly reducing the probing time and effort in final test and follows two objectives: (1) Identify a limited set of chips that have to be tested. (2) Reconstruct the parameters also from those chips that were not probed; this includes the detection of defect chips. To achieve these objectives, up-stream metrology data is utilized. A set of machine learning algorithms (including a neural network) takes these data to identify critical chips and to predict probing results.

This concept was developed and demonstrated in a 3-years R&D project together with an LED manufacturer. As a result it is possible now, to omit the measurement of 93% LED chips on a wafer, which leads to a drastic decrease in overall measurement time and cost, and still predict the brightness, color and electrical parameters of all LEDs – with an accuracy that fulfils the specification of the manufacturing partner.

The principles of the approach and the knowhow gained during the development can be transferred and applied to other applications and industries, where predictive probing can significantly lower cost and efforts in quality control.

Biography

Martin Schellenberger received the diploma in electrical engineering in 1998 and a Ph.D. in electrical engineering in 2011, both from the University of Erlangen-Nuremberg, Germany. From 1998 to 2006, he was a Research Assistant with the Fraunhofer Institute of Integrated Systems and Device Technology (IISB). Since 2007, he is Group Manager at Fraunhofer IISB, responsible for equipment and advanced process control. His research interests include equipment development and optimization for semiconductor processes, manufacturing science solutions for quality control, predictive methods for process control, equipment automation and productivity enhancement.