Metrology Session

B. Capraro
Research Manager, Silicon Technology
Intel Research and Development Ireland Ltd,
Leixlip, Ireland

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

A. Shmeliov
Research Fellow
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

Education

2009-2014

DPhil in material science, St. Edmund Hall, Oxford University, UK.

DPhil thesis: "Transmission electron imaging and diffraction characterisation of 2D nanomaterials".

2005-2009

First class honours degree in “Physics and Chemistry of Advanced Materials”, Trinity College Dublin, Ireland.

2002-2005

Leaving Certificate, Secondary School, St Joseph’s CBS, Drogheda, Co. Louth, Ireland.

Employment

2014-currently

Research Fellow, Trinity College Dublin, Dublin 2, Ireland. Specialisation in structural characterisation of nanomaterials using transmission electron microscopy.

Teaching

2014-currently

Assisting Prof. Nicolosi in the preparation of the lecture and tutorial teaching materials for the 2nd year undergraduate course “Thermodynamics” and delivering two special tutorials (Foundation Scholarship and End of Year).

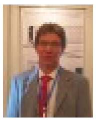
One of the senior supervisors for 3rd year undergraduate practicals in Nanoscience course.

Lecturer for post-graduate course “Introduction to Transmission Electron Microscopy”.

2011-2012

Tutoring Engineering Applications of Polymers and Microstructure of Polymers for the second year undergraduate students in the University of Oxford.

Establishing smart plasma process control in production lines



T. Schütte
President / CEO
PLASUS GmbH, Mering, Germany

PLASUS
Spectroscopic plasma monitor and process control systems

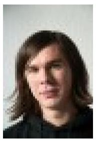
Abstract

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



C. Taudt
researcher/PhD student
Westsächsische Hochschule Zwickau, Optical Technologies, Zwickau, Germany

Westsächsische Hochschule Zwickau
University of Applied Sciences

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.

High-sensitivity detection of electrically active non-visual defects

M. Tallian
project manager
Semilab, Technology, Budapest, Hungary

Abstract

Detecting defects as early as possible is one of the most important needs in semiconductor device production, and there are plenty of methods and tools available to identify defects using visible or ultra-violet light with a variety of dark-field and bright-field techniques during manufacturing. High-throughput electron-beam inspection is also available to catch near-surface defects. However, sub-surface crystalline defects in the active device region, such as dislocations, stress-induced slip-lines, precipitates caused by heavy metal contamination, and similar problems can only be detected after testing, failure analysis and fauilt isolation. We present a novel method, which uses infrared imaging to capture light emitted by the defects themselves in response to an excitation. We show that using this method, certain types of yield-critical defects can be detected and potentially identified early in the front-end process, and corrective actions can be implemented immediately, thus saving valuable time during ramp-up phase. We show that the method is especially suitable for the set-up and control of processes that have a high risk of causing extensive damage in silicon, such as ion implant procedures, or aggressive etch processes.

Biography

Miklos Tallian graduated from the Budapest University of Techology and Economics. He is with Semilab since 2008. His main responsibilities include managing joint European R&D projects, and providing technical support for business development activities.

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

M. Schellenberger
Group Manager Equipment and APC
Fraunhofer IISB, Erlangen, Germany

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.