Thursday Innovation Showcase

The Leading ICP-MS/MS Approach for Measuring Inorganic Impurities : Addressing the New Challenge of Metallic Nanoparticles

A. Brotherhood
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Agilent Technologies, Stockport, United Kingdom

Abstract

To meet the requirements for higher integrated circuit (IC) performance and improved device yield, contamination must be controlled in the wafer substrate and on the surface of the device during fabrication. Given the nanometer scale of device features, there is a critical need to monitor metallic nanoparticles (NPs), as well as dissolved metals.

Analysis of NPs present in bulk chemicals, silicon wafers, and cleaning bath solutions is important. If a particle is present between two metal lines, it may cause electrical shorting to occur and surface defects can affect the growth of new layers on the silicon wafer.

To fully investigate the cause/source of any particle contamination, multi-element analysis of NPs is necessary. ICP-MS is used increasingly to measure nanoparticles directly in sample solutions, using single particle inductively coupled plasma mass spectrometry (spICP-MS). With growing interest in characterizing NPs in various semiconductor samples, the technique is currently being evaluated within the industry.

Biography

Andrew Brotherhood has over 15 years' hands-on experience with ICP-MS, ICP-OES and Ion Chromatography instrumentation. He has mainly worked in the pharmaceutical analysis industry gaining significant experience with developing and validating methods to pharma regulations. Andrew started working for Agilent in January 2018 as an Atomic Spectroscopy Application Chemist based at the Agilent Centre of Excellence in the UK.

The Role of Streaming Data in Smart Manufacturing: Methods, Applications, and Benefits

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VP, New Product Innovations
Cimetrix Incorporated, Marketing, Salt Lake City,
United States of America

Abstract
With semiconductor factories worldwide running a full capacity in most market segments and facing new supply chain challenges every day, it is no wonder that productivity is now an important careabout across the industry. Factory managers carefully monitor their Key Performance Indices (KPIs) for any indications of lost productivity so they can react quickly to identify and address the root causes of these excursions.

It is no longer sufficient to know precisely how well you did last week or even yesterday. Rather, it is important to have a fairly good idea of how well your factory is running right now. This means optimizing the tradeoffs between quality, throughput, capital effectiveness, delivery performance, and perhaps other metrics on a continuous basis.
In such highly constrained situations, the value of the "right" answer decreases rapidly over time, which is the principal criterion for using streaming data in the manufacturing applications that most affect these KPIs. Since the data sources that most accurately represent the true status of manufacturing operations at any instant are the units of manufacturing equipment in the factory, it follows that an equipment integration platform capable of high-volume streaming data collection is a vital component in the factory system infrastructure.

This presentation describes such an environment and highlights not only the sources and methods for streaming equipment data, but also some of the key applications and their stakeholders that leverage this capability. It also identifies the industry standards that are already in place for calculating a wide range of productivity metrics that can impact supply chain performance.

Biography
Alan Weber is currently the Vice President, New Product Innovations for Cimetrix Incorporated. Previously he served on the Board of Directors for eight years before joining the company as a full-time employee in 2011.

Alan has been a part of the semiconductor and manufacturing automation industries for over 40 years. His expertise includes semiconductor design automation, equipment and factory control system architectures, Advanced Process Control (APC) and other key manufacturing applications, SEMI Information and Control standards (especially GEM300 and EDA/Interface A), and Smart Manufacturing Technology.

Alan holds Bachelor's and Master's degrees in Electrical Engineering from Rice University.

Machine Learning Solving the Puzzle in Wafer Anomaly Detection

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Abstract
Traditionally, the detection of Out-Of-Control (OOC) signals as well as the stability of the process flow in semiconductor manufacturing is based on control charts using aggregated data such as mean and range, or standard deviation. Information loss is already generic in extracting only parts of the raw data, especially in complex cases like images and time series. This makes the detection of critical events limited to rule-based automation. Thus, this is where cognitive automation comes in with pattern recognition. Nowadays, multi-dimensional data that carries tens and hundreds of variables have exceeded the limitations of the human observer and current root cause analysis techniques. To solve the problem, camLine aims to introduce machine learning into the SPC framework. The enhancement will combine historical data, inline/online process data, and machine learning algorithms, highlighting the most probable cause from Normal Operation Conditions (NOC). To simplify and automate the analysis of wafer maps in semiconductors, the machine learning techniques create a system that can extrapolate from any set of measurement points to create comparable wafer maps across different measurement sites. Unlike deep learning-based solutions, our system can be trained with relatively small datasets. Only a few hundred wafers from any mix of product designs will suffice. Even for big volume wafers, the system acts efficiently with a snap of response time on wafer scoring, typically within one second.

Biography
Kalle Ylä-Jarkko works as a Senior Data Scientist in Elisa IndustrIQ. Since 2021 he has been developing AI / ML models for camLine's advanced SPC solution *LineWorks SPACE* for complex operational systems in manufacturing, telco and semiconductor industries.
Before joining Elisa IndustrIQ he worked in several laser industry start-ups as a co-founder and technology developer in different engineering and product development positions. His work's main focus has been developing stable photonics production processes through the effective utilization of data mining technologies and process measurements.
He holds M.Sc. and Ph. D. degrees in Engineering Physics and Optoelectronics from the Aalto University, Finland. He is an inventor and co-author of 6 patents and over 30 papers in the field of laser technology, laser machining, machine learning, and AI applications.

A reliable manufacturing solution to enable normally-off recessed gate GaN MISHEMT by atomic layer etch and in-situ etch depth monitoring

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Abstract

GaN HEMTs for power electronics applications is projected to be a $1b market by 2030 and is a critical enabling technology in some very high growth markets like USB-C fast-chargers, automated vehicles and datacentres. The benefit of GaN HEMTs for these applications is that they deliver high breakdown field, high-temperature operation, and their strong spontaneous and piezoelectric polarization-induced 2D electron gas (2DEG) of high carrier density and mobility. There are multiple device geometries and production routes to commercialising these more efficient, higher operating temperature, smaller, lighter, and lower cost GaN-based power semiconductors. However, a key attribute for power applications is that the GaN HEMT is “normally-off” in operation for safety and fail-safe requirements. One device solution that meets these requirements is the recessed gate GaN MISHEMT. A critical technology challenge is to ensure that the recessed gate is formed by etching to reliably and repeatably leave a thin (<5 nm) layer of AlGaN with an accuracy of ±0.5 nm. We present data demonstrating our low damage, and repeatable atomic layer etch process that has been validated by an optimised in-situ endpoint monitoring solution to achieve this AlGaN thickness accuracy. In addition, the recessed gate GaN MISHEMT device has achieved normally-off behaviour delivering a viable solution for this device geometry in high volume manufacturing.

Biography

Aileen O’Mahony is an Atomic Scale Processing Product Manager at Oxford Instruments Plasma Technology. Aileen has a PhD in Chemistry from University College Cork, Ireland, in the field of Atomic Layer Deposition (ALD) for microelectronics applications. Aileen has worked in the US and UK on industry-driven process development for the commercialisation of ALD-functionalised products and is now focused on advancing Atomic Scale Processing product solutions at Oxford Instruments. She is the author and co-author of over 20 publications, and has presented at numerous international conferences and workshops.

An Omnivariate Test Data Approach to Reliability Improvement for Aerospace and Automotive Applications

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CEO
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GALAXY
SEMICONDUCTOR INTELLIGENCE

Abstract

As the number and complexity of electronic parts increases with every vehicle, the demands for reliability continually increase. This is even more acute when deploying advanced materials such as SiC and GaN to address the ever more stringent demands for electric powertrains.

An advanced statistical screening approach is proposed for the purpose of identification of electronic parts that have an elevated risk of field failure. A comparison is made between the proposed Omnivariate approach, industry-standard DPAT, and more commonly recognized multivariate methods such as Mahalanobis Distance and Hoteling T^2, which tend to provide less useful information as the number of monitored parameters exceeds a few hundred.

A few examples from Silicon CMOS and SiC Power device manufacturing are used for demonstration.

Biography

Mr. Smith is currently serving the industry as CEO of Galaxy Semiconductor. He has been in the industry for 27 years, serving in multiple engineering, sales, product management and most recently senior management positions. He has a Masters from USC, and a Bachelors degree from Clemson University.

Feeding AI’s Demand for Data

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Abstract

Advancements in the semiconductor industry play a major role in enabling the adoption of complex Artificial Intelligence (AI) technology. With developments in AI calling for more computing power, faster storage, and more networking resources in data centers, ensuring that data speeds do not become a bottleneck is critical to furthering the potential of AI technology.

To address the need for more computational power, the semiconductor industry is shifting away from monolithic dies to architectures based on chiplets. Co-packaged AI chiplet clusters can offer greater performance, but require high-speed dense interconnections and must be fed orders of magnitude more data. Unfortunately, existing connectivity technologies are simply unable to meet this demand, causing bottlenecks that limit progress on AI.

Solving this bottleneck will require the semiconductor industry and interface connectivity innovators to come together, providing faster communication between AI chiplets and to external storage. Connectivity IP companies will leverage advances in semiconductor manufacturing and packaging to create interface connectivity technology that transfers data at higher rates and more reliably. The result will be massively parallel processors spread across dozens of chiplets interconnected seamlessly with terabytes per second of memory bandwidth. These innovations are necessary for chiplets to realize their fullest potential.

With increasing demand for sustainable, efficient AI, the semiconductor industry and interface connectivity must work closely now to lay the foundations for the future of computing.

Biography

Tony Chan Carusone was appointed Chief Technology Officer in January 2022. Tony has been a professor of Electrical and Computer Engineering at the University of Toronto since 2001. He has well over 100 publications, including 8 award-winning best papers, focused on integrated circuits for digital communication. Tony has served as a Distinguished Lecturer for the IEEE Solid-State Circuits Society and on the Technical Program Committees of world's leading circuits conferences. He co-authored the classic textbooks “Analog Integrated Circuit Design” and “Microelectronic Circuits” and he is a Fellow of the IEEE. Tony has also been a consultant to the semiconductor industry for over 20 years, working with both startups and some of the largest technology companies in the world.

Tony holds a B.A.Sc. in Engineering Science and a Ph.D. in Electrical Engineering from the University of Toronto.

Sensor Integration Framework with Interface A

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Abstract
Within the last few years, semiconductor, photovoltaic or HB-LED industry developed enormously. With the result that the complexity of almost all relevant processes increased. To prevent the increase of corresponding costs, a concept of Equipment Engineering Systems (EES) is essential. Integrating applications like Equipment Data Control, Advanced Process Control (APC) and Fault Detection Control (FDC) is fundamental to improve product yield and reduce manufacturing costs. Nevertheless, adapting APC solutions to relevant processes in semiconductor, photovoltaic or HB-LED factories remains a huge challenge.

To accomplish efficient machine integration of technical data, which is the basis for APC applications, internationally standardized and high-efficient interfaces are obligatory. In addition to the already established SECS interface, which also has established itself during recent years as PV02 interface in the PV industry, first results from high volume productions show that these interface technologies are not enough. They must be supplemented to meet the high data volume and the flexible adjustments. A few years ago, the SEMI Organization has defined the Interface A Standard which should give an answer to the named problems. In addition to its modern and highly efficient software technology, functional properties like the Interface A self-description make this standard very interesting for APC applications for high-efficient designed FAB's because a very strong motivation is to make the process engineer independent of the IT-Department. They need solutions which enable the engineer to configure the data stream online. The amount of data and their frequency must be defined at the time of their need

For this reason, making an effort to implement the Interface A technology as an embedded solution in other software components, certainly can be a useful strategy. In particular, the ability to synchronize sensor data, process data and logistic parameters makes this approach very interesting. This paper presents a framework to simplify the interface between a variety of external sensors and consumer devices. These abstractions facilitate a componentized framework that allows developers to focus on writing minimal pieces of sensor-specific code enabling an system of reusable sensor drivers.

Biography

Dipl.-Ing. Bert Mueller
Company: Kontron-AIS GmbH
Postion in the Company: Head of Business Unit System Integration
professional career:
1995 diploma in Automation Technology, received from TU Dresden
1995-2000 AIS Automation Dresden GmbH as SW Developer
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