
## SMART Mobility Forum

## SiC in the Automotive Supply Chain

S. Price
CEO
Exawatt, Sheffield, United Kingdom

**Abstract**
Silicon carbide (SiC) has the potential to dominate EV power electronics manufacturing in the coming years, due to the numerous benefits it offers EV makers, including improved performance, reduced size and weight, and increased vehicle range. However, there is a widespread misconception that SiC is not yet ready for the mass market, due to concerns over the technology's maturity, its high cost relative to silicon and its suitability for mainstream vehicles. This presentation will examine the status and prospects of SiC in EVs and will discuss the developments that must - and will - happen to drive SiC market share.

**Biography**
Simon Price is CEO of Exawatt, a provider of strategic consulting, technology analysis and cost forecasting to manufacturers in the solar PV, EV, power electronics and lithium-ion battery industries. Exawatt's work is united by a common theme: decarbonisation via electrification.

Prior to founding Exawatt in 2015, Simon 2010 was a member of the founding team of PV Tech Group, which provided factory design and integration services to solar PV companies. He has been active in PV since 2008, when he was part of the founding team of a startup technology company dedicated to improving the efficiency of crystalline solar cells.

Previously, as a management consultant in the interactive entertainment industry, Simon provided services to a number of industry-leading manufacturers, including Microsoft, Sony, Intel and Nokia. Other clients included software publishers and financial institutions. Simon began his career as a business journalist, overseeing two of the interactive entertainment industry's leading publications.

Simon has an MSc in Science Communication from Imperial College of Science, Technology and Medicine, University of London, and a BEng in Electrical and Electronic Engineering from the University of Newcastle upon Tyne, UK.

## High end power device manufacturing – substrate manufacturing and handling at the transition from Si to Compound Semiconductor materials

E. Brandl
Business Development Manager
EVG, St Florian am Inn, Austria

**Abstract**

Electronic vehicles, renewable energy and the overall efficiency of power supply are driving new developments within the power electronics industry. In particular more efficient power conversion and reduced switching losses for high voltage applications have to be addressed with novel solutions. In the last years a trend towards Silicon Carbide (SiC) and Galliumnitride (GaN) could be observed, but the transition to these materials must overcome technological and economical challenges to get a high implementation acceptance.

Although quite different in the device architecture, SiC and GaN power device manufacturing can benefit from temporary wafer bonding. For SiC, temporary bonding offers mechanical support for thinning and backside processing of vertical power devices. For GaN, typically at the moment grown on Si and SiC, temporary bonding is utilized for mechanical support during substrate removal to allow a better heat distribution of the lateral devices.

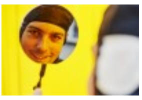
In this presentation we will review temporary and permanent bonding technologies enabling a better and more cost effective manufacturability of SiC and GaN power devices.

Part of the work presented was obtained within the EU funded project REACTION under the coordination of ST.

**Biography**

Elisabeth Brandl received her master in technical physics from the Johannes Kepler University Linz, Austria in Semiconductor and Solid State Physics. Since 2014, she has been responsible for Product Marketing Management for temporary bonding and compound semiconductors at EVG.

**Journey and Development history on SiC from 2015-2020: "From Single-Wafer Metal-Lift-off to Metal etch to Metal-Etch via Batch process"**



S. Zürcher
Team Leader Process Engineering & Laboratory
AP&S, Donaueschingen, Germany

**Abstract**

With this presentation we take you on an exciting journey around the topic of SiC. Using concrete practical examples, we will show you how wet process technology goes hand-in-hand with the customer - one of the world's leading semiconductor manufacturers worldwide. How wet process technology reacts flexibly to changes in customer production, responds to new challenges and develops concrete customer-specific solutions. Starting with a metal-layer process, over the optimized process metal-lift-off with DMSO as single wafer processing, metal-etching processes with end-point detection (also single wafer) up to the etch process of the innovative substrate SiC in the batch application. Both the changes in the semiconductor manufacturing processes, such as process modification and throughput increase, and the solutions derived from them in wet chemical processing will be presented. This is a success story resulting from close cooperation between a semiconductor production and a supplier of wet processing equipment and our famous DEMO & R&D center. Clear breakdowns of the various process data, parameters and conditions provide you with a detailed overview of the development from 2015 to 2020. Join us and experience the fascinating world of wet process technology!

**Biography**

Stefan Zürcher started in 2011 at AP&S as process engineer for wet chemical batch processes (etching, cleaning, UBM-eless plating, drying). Within 2012 he worked in the R&D department for batch and single wafer equipment and in the application laboratory at the AP&S headquarters. Becoming manager of the new AP&S Demo Center in 2015 and AP&S process manager in 2017. He is responsible for all tasks related to process performance, optimization and development on AP&S wet process equipment in single wafer, batch and parts cleaning applications. Patents in UBM-eless metallization technologies.

## Gallium Nitride Technology to Meet Automotive High Reliability Requirements

K. Smith
VisIC Technologies, Nes Ziona, Israel

**Abstract**

The unique structure of wideband GaN devices creates a device with very high transport characteristics with high charge density in the channel that operate at high voltages. These characteristics allow the devices to operate at much higher frequencies and with fewer parasitics. Inherent in these unique characteristics is a flexibility in device design to allow robust operation and high performance. As shown in by the measured operational locus for VisICs $D^3$GaN power devices, GaN devices operate at current levels well below the maximum current and at voltages well below the blocking (similar to breakdown) voltages. This paper will show the reason, necessity, and testing of these design conditions in creating a highly reliable device needed for automotive applications.

Yet, all Gallium Nitride transistors are not the same. Even outside of the device design parameters necessary to establish a proper overhead, the intrinsic device should be chosen to best satisfy the needs of the application. There are 2 implementations of lateral GaN power devices: a normally on or depletion mode (D-mode) device and a normally-off or enhancement (E-mode) device. While each device has it's advantages and disadvantages, understanding these tradeoffs are necessary to make a proper choice for the chosen application. The gate region is very different for these two implementations and plays a critical role in the potential reliability. $D^3$GaN D-mode technology has a very robust gate structure as illustrated here. Additional characterization and testing will be shown to illustrate both the reliability and understanding of why VisIC's $D^3$GaN D-mode technology is the best choice to meet the high-reliability needs of the automotive sector.

**Biography**

Kurt has 18 years of experience in Gallium Nitride Reliability. He has worked in RF GaN with Raytheon supporting reliability analysis of high power RF amplifiers for radar and other high-frequency applications. More recently, Kurt was the Reliability Manager at Transphorm, working on high voltage power devices. He was responsible for reliability testing, analysis and degradation models to support both physical understanding of factors contributing to the reliability of devices and customer requests for specialized testing and understanding. Kurt is currently a member of the leadership team for the JEDEC J70 efforts to develop standards for GaN and SiC testing, datasheets and reliability

Kurt is a veteran of the USNavy, where he was a Nuclear Machinist Mate. He received his BS, MS, and Ph.D. at the University of California, San Diego

## How to Support the Functional Safety Requirements of the Automotive Industry

A. AMADE
Senior Director, EMEA/NA Entegris Automotive Program
ENTEGRIS, Moirans, France

**Abstract**

About 90% of all innovations in cars have their origin in electronic systems, whose heart is semiconductor related. The rapid increase of semiconductors in cars enables significant safety, connectivity, and mobility improvements. If the future of transportation will rely on autonomous vehicles, the definition of electronics' reliability and operating lifetime will significantly change. The move towards advanced nodes and integration of new materials is inescapable. But inspection tools available in the semiconductor industry today have limits to detect reliability defects and testing cannot compensate for this gap.

Controlling contamination shall contribute significantly to eliminate the root cause of defects and thus enhance the functional safety of electronics systems in the car. Three areas of impact must be considered: the ambient air in the fab, the environment that surrounds the wafer during its lifetime, and the integrity of the materials across the clean chemical delivery pathway.

As part of the New Collaborative Approach presented last year at the European SMART Transportation Forum, Entegris has organized Technology Days, Process Efficiency Enhancement Reviews and Benchmarks in interaction with the main representatives of the ecosystem. For this SMART Mobility Forum, a detailed analysis will be provided on the major technology nodes in play for the current and future generations of cars. What do we learn in terms of the maturity of our ecosystems? Is there any correlation with the main technology inflection points? What are the trends from a contamination and defectivity management? Where should semiconductor manufacturers focus their efforts? Entegris will share these insights during this session.

The automotive industry is in a transformation phase, so let's collaborate now to better address the zero defects requirements.

**Biography**
**Antoine AMADE**
*Senior Director, EMEA/NA Entegris Automotive Program*

Mr. Amade joined Entegris in 1995 as an application engineer in its semiconductor business. Today, he is the EMEA/NA senior director focused primarily on growing the semiconductor business in North America, Europe and the Middle East through market strategies and the management of sales. For nearly 25 years, Mr. Amade has held leadership positions at Entegris in gas microcontamination market management, strategic account management, and regional sales management. Mr. Amade has a degree in Chemical Engineering from ENS Chimie Lille and is a member of the SEMI Electronic Materials Group, the Global Automotive Advisory Council for Europe (GAAC) and the Platform for Automotive Semiconductor Requirements Along the Supply Chain (PASRASC).

**Next Generation Radar- a Game Changer for Truly Safe and Smart Mobility**

K. Marenko
Founder and CEO
Arbe, Tel Aviv, Israel

**Abstract**
To meet the demands of smart and autonomous vehicle production, Tier 1s, OEMs and New mobility players need a sensing solution that can instantaneously respond to a full range of driving scenarios — identifying and assessing risk and executing path planning while offering a smooth driving experience for both the driver and those sharing the road.
While this may sound feasible in theory, there are two major problems that challenge this notion. The first is that there is not a sensor suite capable of the achieving the desired level of performance and safety on the market. The second is that many of today's sensor suites rely on expensive solutions, that limit the availability of ADAS and AV to premium and luxury vehicles.
Through innovative use of proprietary radar technology and artificial intelligence (AI) algorithms, the combined technology enables a high sensitivity tracking that individually identifies entities such as pedestrians, bikes, and motorcycles even when partially concealed by vehicles or stationary objects. Direction, speed and velocity can be continuously sensed, delivering all levels of autonomous vehicles unceasing situational awareness in high definition. By analyzing the data gather from thousands of virtual transmitting and receiving channels, and significantly reducing the occurrence of false alarms to near-zero, next generation radar is poised go from a supportive sensor to the backbone of the autonomous sensor suite — a true game changer.

**Biography**
Kobi Marenko, co-founder and CEO, Arbe is a successful entrepreneur with over 20 years of experience leading technology and media startups from the seed stage to acquisition. Before founding Arbe, Kobi was the Founder and President of Taptica, a mobile DSP acquired by Marimedia, and Founder and CEO of Logia, a mobile content platform acquired by Mandalay Digital. At Arbe, Kobi, and the team are leading a RADAR REVOLUTION with an unparalleled 4D high-resolution imaging radar technology. Together, the team is driving a zero-road-fatality reality by enabling truly safe driver-assist systems, paving the way for a fully-autonomous driving future.
With $55M raised to date, Arbe has been recognized by Gartner, Frost & Sullivan, Tech AD, TechCrunch Disrupt TLV and Wired Magazine as a groundbreaking company disrupting the automotive market.

**Short-Wave Infrared Breaking the Status Quo - Identifying Hazards on the Road and Solving the Low Visibility Challenge**

Z. Livne
Chief Business Officer
TriEye, Tel Aviv, Israel

**Abstract**

One of the most basic challenges for ADAS and Autonomous Vehicles (AV) is the ability to operate in all weather and lighting conditions. Increasingly, sensing solution architects are realizing existing sensor fusion solutions (including radar, lidar, and standard cameras) are unable to detect and recognize potential hazards under common low-visibility conditions: night time, fog, haze, etc. Meaning machine vision algorithms are unable to make reliable and safe driving decisions.

TriEye is breaking the sensor fusion status-quo with a CMOS-based Short-Wave Infrared (SWIR) HD-camera. Based on advanced nanophotonics research, enabling fabrication of low-cost SWIR sensors at scale, solving the low visibility challenge for OEMs and T1s.

In the presentation TriEye will explain why SWIR spectrum can support automotive applications better than VISBLE\NIR\FIR through fog, dust, night time, etc. Additionally, we will present experimental results which compare the contrasts of visible and SWIR camera images of the same scene, imaged through common fog types and imaging at night.

**Biography**

Ziv Livne is the VP Product and Business Development at TriEye, where he is part of the founding team that achieved a mass-scale technological breakthrough in record time, creating a giant leap in ADAS and AV safety, reliability, and functionality. He has vast experience in R&D, product and business development from various startups and large corporations. Ziv was also an Investment Director at Grove Ventures, where he managed several investments in cutting edge technologies. Ziv has a BSc in Electrical Engineering from the Technion - Israel Institute of Technology, and an MBA from Tel Aviv University.