Materials Innovation

Supply Chain Collaboration & Resilience: Building and Enabling the European Ecosystem

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Abstract
AI, autonomous driving, and smart manufacturing are among the leading trends for digital transformation, with semiconductors being integral to these advancements. The EU has the potential to revitalize its semiconductor industry, but this can only be achieved through the development of a comprehensive ecosystem and by harnessing the strengths of local players in the value chain. Merck, a leading materials and equipment supplier based in Germany, has been an innovative and transformative partner for semiconductor players worldwide. We have applied our Materials Intelligence to unlock next-generation chips by combining our expertise in chemistry, physics and science with AI solutions. In this talk, we will explore the areas that require the collective attention of EU semiconductor players today to ensure our mutual growth and success in the future. This includes fostering closer collaboration across the value chain, expanding production capacity, strengthening supply chain resilience, and nurturing materials innovation to align with future technology roadmaps.

Biography
Benedikt Ernst is Vice President and Head of Strategy Transformation at the Electronics business of Merck. As a member of the Electronics Executive Committee, he is responsible for the end-to-end strategic development and transformation of the business sector, encompassing market competitive intelligence, strategic roadmap, business transformation programs, and business and portfolio development. He joined in Merck in 2006, and has had various management positions. Since 2018, he has been heading Strategy and Business Development for Electronics and Semiconductor. Before he was Commercial Director for the Semiconductor business and Head of Packaging Business Field. Benedikt Ernst studied physics at the Technical University of Munich and at the Max Planck Institute of Plasma Physics.

References

Atomic Layer Deposition of 2D Materials For Electronics and Energy

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Abstract

Two-Dimensional (2D) materials are among the top candidates for enabling continued scaling of microelectronics due to their atomically thin nature and attractive properties. Transition metal dichalcogenides (TMDCs) range from semiconductors to (semi)metals. Semiconducting TMDCs including MoS_2 and WS_2 have attracted attention for future nano(opto)electronics. Yet, deposition processes producing uniform, thickness-controlled films on wafers and three-dimensional structures required to fulfil these promises are lacking. Additionally, meeting the thermal budgets of different applications is a major challenge. ALD, a method already in widespread use in the semiconductor industry, can meet these requirements. In this talk, I will discuss both successes and remaining challenges in ALD of 2D materials. One direction we have pursued is broadening the process toolbox to include materials with higher band gaps (ZrS_2, HfS_2, SnS_2) or metallic nature (e.g. TiS_2). The flexible nature of TMDCs also make them an attractive choice for flexible electronics, yet deposition processes compatible with typical polymer substrates are lacking. I will discuss a record-low temperature plasma-enhanced ALD process tailored for this challenge.

Beyond energy-efficient electronics, electrocatalysis is a key process in creating a sustainable future based on renewable energy. One promising application of TMDCs is in water splitting as an alternative to scarce and expensive platinum as the hydrogen evolution reaction (HER) catalyst in acid (proton exchange membrane electrolyzers). Beyond electronics, TMDC ALD processes can be used to synthesize both model catalysts for fundamental studies and industrially relevant, high-performance catalysts on high surface area supports that minimize the required catalyst loading.

The overarching theme of my talk is the key role that ALD chemistry plays in realizing scalable synthesis of 2D materials for semiconductor as well as energy applications of the future

Biography

Dr. Miika Mattinen is a Research Council of Finland postdoctoral researcher in the HelsinkiALD group (University of Helsinki). He received his PhD from the University of Helsinki in 2020, followed by postdoctoral positions at Eindhoven University of Technology (2021-2022) and Stanford University (2022-2023) prior to returning to Helsinki. He has worked on ALD since 2014 and on 2D materials since 2016, exploring especially at semiconductor and electrolyzer applications among many other applications and materials. He has co-authored 41 peer-reviewed publications and three patents.

References

Integrated (PE)ALD solutions for interface engineering in Power Electronics

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Abstract
Challenges typically associated in the most advanced nodes of leading-edge applications, where interfaces drive the majority of the device properties, are increasing being seen in specialty devices, such as Power Electronics. From 2DEG control in GaN HEMT devices to mobility enhancement in SiC devices, integration of multiple steps in a system capable of, for example, pre-clean, PEALD, preferably with a remote plasma source, and ALD. While ALD is the best-in-class solution for high density and conformal layers, addition of pre-clean and/or PEALD deposition without vacuum break in-between the steps allows new surface and interface engineering capabilities, resulting in a dramatic increase in the ALD adoption.

Biography
Christoph Hossbach is part of Applied Materials European Central Sales team as an account sales manager and as product sales specialist for Picosun products. In 2017 he joined Picosun, which became part of Applied Materials in 2022. Before 2017 Christoph has worked as a Senior Scientist at Technical University of Dresden, where he received his Dr.-Ing. in Electrical Engineering in 2013. His fields of expertise include Atomic and Molecular Layer Deposition and related applications, Chemical Vapor Deposition, metrology, as well as design of tools and components. Dr. Hossbach is co-founder of ALD-Lab Saxony and Atomic Layer Process Innovation Network (ALPIN).

References