

TEHCET

Electronics Materials Information



2022 CRITICAL MATERIALS REPORT™ ON CVD/ALD METAL PRECURSORS

Prepared By:

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RESEARCH METHODOLOGY

TEHCET employs subject matter experts having first-hand experience within the industries which they analyze. Most of TEHCET's analysts have over 25 years of direct and relevant experience in their field. Our analysts survey the commercial and technical staff of IC manufacturers and their suppliers, and conduct extensive research of literature and commerce statistics to ascertain the current and future market environment and global supply risks. Combining this data with TEHCET's proprietary, quantitative wafer forecast results in a viable long-term market forecast for a variety of process materials.

READER'S NOTE

This report represents the interpretation and analysis of information generally available to the public or released by responsible agencies or individuals. Data was obtained from sources considered reliable. However, accuracy or completeness is not guaranteed.



ANALYST BIOGRAPHY

Jonas Sundqvist, Ph.D. – Sr. Technology Analyst of TECHCET— covers Electronic Gases and ALD & CVD precursors and related technologies, and the co-chair of the Annual Critical Materials Council (CMC) Conference. His over 20 years of work experience includes Group Leader of the Thin-Film Technologies Group at The Fraunhofer Institute for Ceramic Technologies and Systems (IKTS) in Germany, Clean Room Operations Manager for Lund Nano Lab, Lund University in Sweden and Group Leader of the ALD & High-k devices group at Fraunhofer's Center Nanoelectronic Technologies (CNT) in Germany, which included 28nm node work for GLOBALFOUNDRIES Fab1.

Previously, at Infineon Memory Development Centre (MDC), he developed high-k and metal nitride ALD processes, and at Qimonda, he was a materials manager focused on the ALD/CVD precursors supply-chain. He holds a Ph.D. and an M.S. in inorganic chemistry from Uppsala University, Sweden & Institute for Micromanufacturing, Louisiana Tech, USA, a B.S. in electrical and electronics engineering from Lars Kagg, and nine patents and 40 related scientific publications.

Jonas Sundqvist is on the Scientific Committee for AVS ALD and has co-chaired ALD2016 Dublin Ireland, and the annual EFDS ALD for Industry Workshop in Germany.

Jonas Sundqvist, Ph.D.



Jonas Sundqvist,
Sr. Technology Analyst of TECHCET,
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2

SCOPE, PURPOSE AND METHODOLOGY

2.1 SCOPE

- This report provides business and technical trend information on organic and inorganic gases, liquid and solid chemicals used for CVD, ALD metal and metal-oxide precursors. For the last 20 years, there have been many research papers and patents published regarding ALD and CVD precursors specifically for the semiconductor industry. This report includes detail on the development path and roadmaps for new precursors and any current EHS and regulatory hurdles for these materials to enter into high volume manufacturing (HVM).
- The focus is on the leading-edge front end of the line, and insulating interconnect materials. These process areas are of interest because of the high growth potential associated with leading-edge logic <45 nm, 28 nm to 10/7 nm nodes, and the future 5 & 3 nm nodes, as well as advanced DRAM and 3DNAND volatile and non-volatile memories. New memory technologies like STT-MRAM, Resistive RAM, Ferroelectric RAM, and FETs, and Cross Point Memory will emerge in the coming 5 years. Today the recent NAND transition to 3DNAND and continued vertical scaling will drive growth for metal and dielectric precursors.

2.2 PURPOSE

- This Critical Materials Report™ (CMR) provides focused information for business managers (supply-chain and business development), process integration and R&D directors, as well as financial analysts. The report covers information about key suppliers, issues/trends in the material supply chain, estimates on supplier market share, and forecast for the material segments.

2.3 METHODOLOGY

- TECHCET employs subject matter experts having first-hand experience within the industries which they analyze. Most of TECHCET's analysts have over 25 years of direct and relevant experience in their field. Our analysts survey the commercial and technical staff of IC manufacturers and their suppliers and conduct extensive research of literature and commerce statistics to ascertain the current and future market environment and global supply risks. Combining this data with TECHCET's proprietary, quantitative wafer forecast results in a viable long-term market forecast for a variety of process materials.

2.4 OVERVIEW OF OTHER TECHCET CMR™ REPORTS

- TEHCET produces electronic material supply chain reports each year as one of its functions for the Critical Materials Council. Reports to be published in 2022 can be found at www.techcet.com and are listed in the table below:

	Critical Materials Reports™
1	CMP Pads and Slurry
2	Electronic Gases
3	Photoresist
4	Precursors - Dielectric Precursors
5	Precursors - Hi K / ALD CVD Metal Precursors
6	Silicon Wafers
7	Specialty Cleaning Chems / Wet Chems
8	Metal Chemicals
9	Targets
10	Equipment Components – Quartz
11	Equipment Components – Ceramics/SiC
12	Equipment Components- Si parts
	Special Reports
13	Impact of US Chip Expansions
14	Impact of European Chip Expansions