



Electronics Materials Information



CMC ADVISORY ALERT:
THE IMPACT OF EXPANSION ON THE MATERIALS
SUPPLY CHAINS

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IMPACT OF FAB EXPANSION ON THE US DOMESTIC MATERIAL SUPPLY CHAIN

DR. DAN TRACY, SENIOR DIRECTOR,
TEHCET

BRUCE LIPSKO, SENIOR DIRECTOR,
TEHCET

OUTLINE:

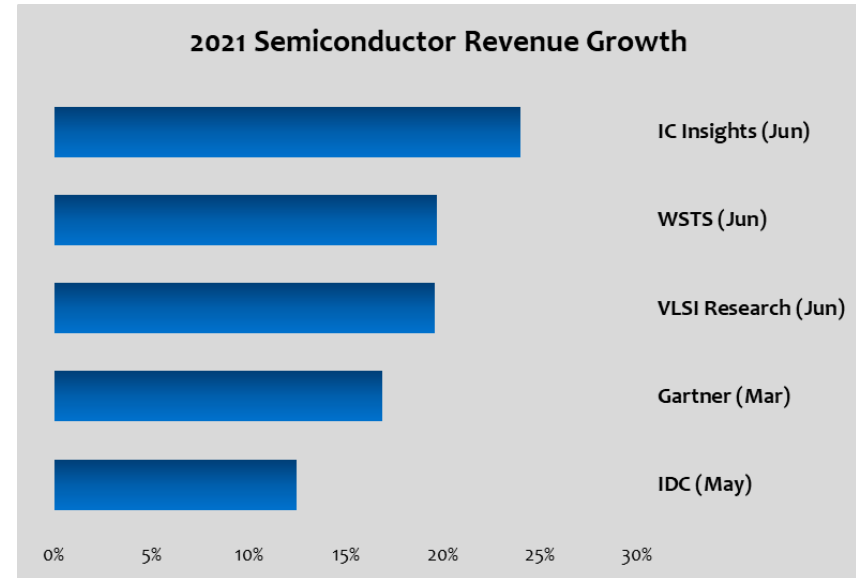
- ▶ Short term Industry Outlook
- ▶ Announced US Fab Expansions
- ▶ Impact on Wafer Starts
- ▶ Impact on Bulk Chemical Requirements
- ▶ TECHCET Assessment

SEMICONDUCTOR MARKET TRENDS

- ▶ GDP recovers for all advanced economies.
- ▶ Semiconductor market is forecasted experience 20% or more revenue growth for the year.
- ▶ Top challenges to growth include economics, geopolitics, length and severity of pandemic – including the effectiveness of the vaccine roll out globally and the impact of corona virus variants:
 - ▶ Strong economic recovery is straining supply chains across the economy.
 - ▶ Impacts delivery of manufacturing equipment needed by companies to ramp production.
- ▶ Trade and IP concerns remain, especially between China and the U.S.
- ▶ Highest materials growth areas include metals/ precursors, cleans followed by CMP and Photoresists:
 - ▶ Driven by 3DNAND, DRAM, and advanced Logic

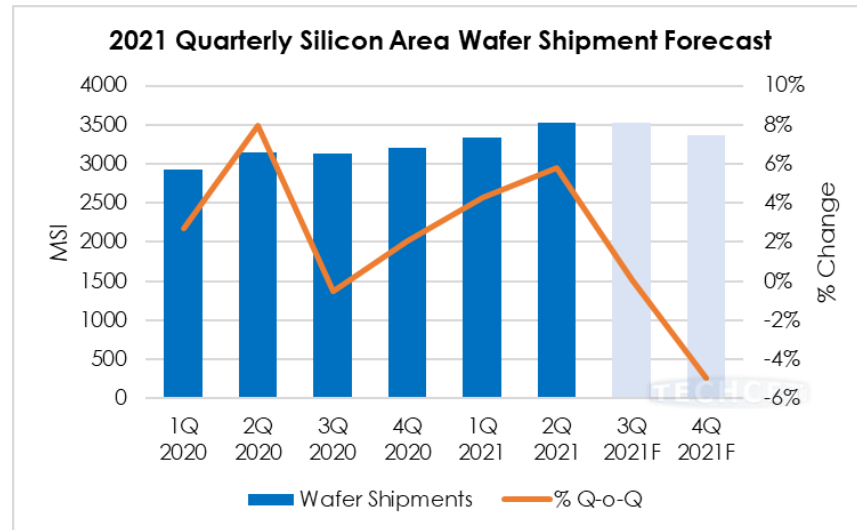
SEMICONDUCTOR INDUSTRY OUTLOOK

- ▶ Semiconductor market is forecasted experience very healthy growth in 2021
 - ▶ Many analysts forecasting double-digit revenue growth for the year, as high as and even topping 20% revenue growth
- ▶ Increase in smartphone shipments, continued rollout of 5G, demand growth in data centers and the recovery and growth for automotive electronics
- ▶ Possible negatives to the forecast remain stagnant economic recovery from the pandemic, vaccination roll out, and trade issues.



QUARTERLY SILICON WAFER SHIPMENT TRENDS

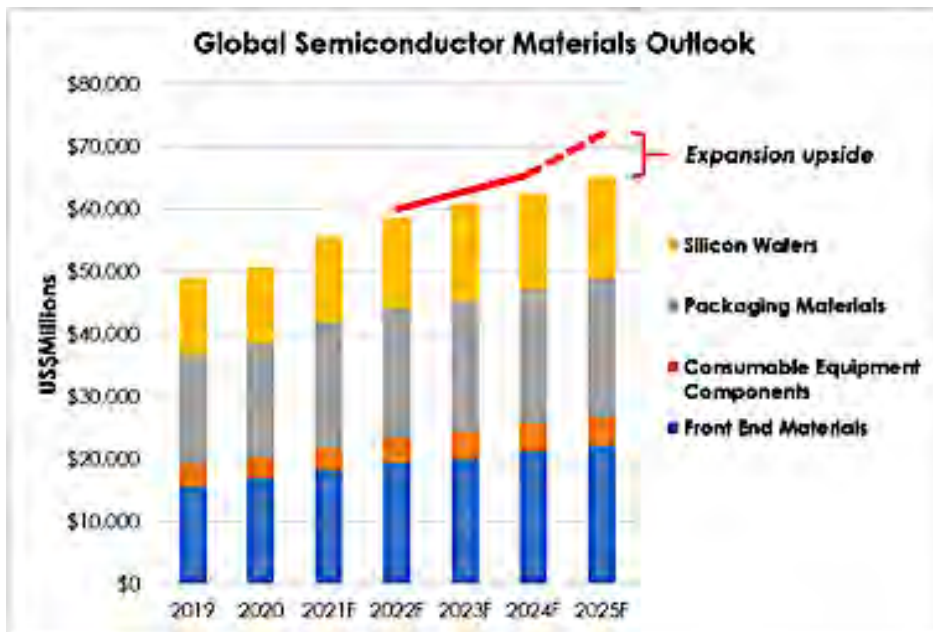
- ▶ 2Q 2021 wafer shipments grew over 5% from 1Q 2021 shipments
 - ▶ All time record high quarterly shipments
 - ▶ 1H 2021 shipments 13% above 1H 2020 shipments
- ▶ Assuming 10% shipment annual growth in 2021, a seasonally expected slowdown in wafer shipments will payout in 4Q 2021.
 - ▶ 300 mm to grow +11.3%
 - ▶ 200 mm by 7.2%



Source: TECHCET/SEMI SMG

SEMICONDUCTOR MATERIALS FORECAST

- ▶ Total materials revenues will top \$55B this year growing by 10%
- ▶ With growth projected for 2021 through 2025
 - ▶ 5% CAGR
 - ▶ Upside potential in latter years of forecasts given fab announcements
- ▶ Highest materials growth areas include metals/precursors, cleans, CMP, SOI wafers, and Photoresists



MAJOR US ANNOUNCED FAB EXPANSIONS

IDM	Location	Planned/Announced
Texas Instruments	Richardson, TX	300mm fab with 40K WSPM planned capacity Acquired 300mm fab in Lehi, UT from Micron
Samsung	Austin, TX (Tentative)	300mm foundry with 35K WSPM planned capacity
Intel	Chandler, AZ	300mm MPU logic fab with 40K WSPM capacity
Intel	Hillsboro, OR	300mm MPU/logic with 33K WSPM planned capacity
Intel	Rio Rancho, NM	Expansion
Micron	Manassas, VA	300mm fab with 35K WSPM planned capacity
TSMC	Phoenix, AZ	Announced 300 mm "Gigafab" ramping to X WSPM over a five-year period
GlobalFoundries	Malta, NY	Expansion of existing Fab in Malta, NY Announced a new fab there as well.
Cree	Durham, NC Marcy, NY	US\$1 billion investments in SiC device and wafer manufacturing, including plans for 200 mm SiC
Skywater	Bloomington, MN	Specialized Foundry in support of DOD. Capacity not announced.

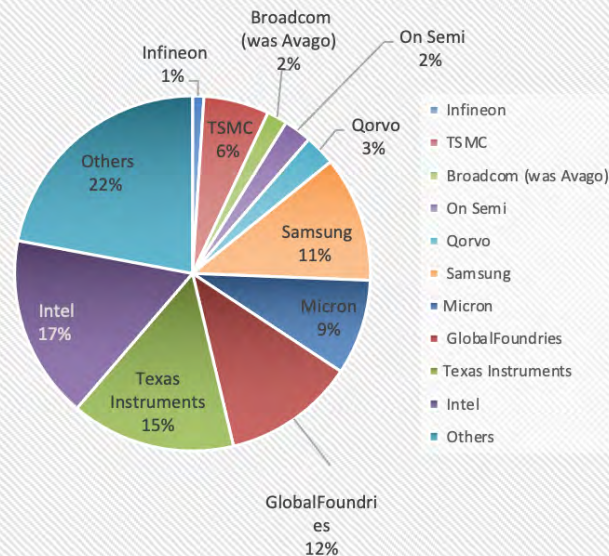
THE ANNOUNCED EXPANSIONS WILL HAVE A MAJOR IMPACT ON WAFER STARTS

- As these announced expansions and new fabs come on-line annual US domestic wafer start capacity will jump to approximately 36 million by 2025 from current levels of roughly 26 million in 2020*.
- These estimates are derived from TECHCET's primary and secondary research** focused on device production by the leading manufacturers and the type and geometry of devices they fabricate:
 - Intel Infineon
 - Micron GlobalFoundries
 - Samsung TSMC
 - TI Other

* Annual wafer start capacity of 36M represents 200mm wafer equivalents (eq), or 16M 300mm eq; 26 M 200mm eq. = 11.6M 300mm eq.

** Primary market research included interviews with leading IDMs and suppliers; secondary market research included SEMI WFF.

Figure 1: 2025 Chip Fab Capacity - 36M /Yr



CHEMICAL VOLUME DEMAND GROWS UP TO 56%

- ▶ The growth in wafer starts and the concurrent material requirements will disrupt the existing supply chain but will not impact all materials equally with bulk process chemicals affected to the greatest extent:

- ▶ H₂SO₄ H₂O₂
- ▶ NH₄OH HF
- ▶ HCL H₃PO₄
- ▶ IPA HNO₃

- ▶ The requirements for these chemicals will increase from 13% to more than 50% from 2020 consumption levels.

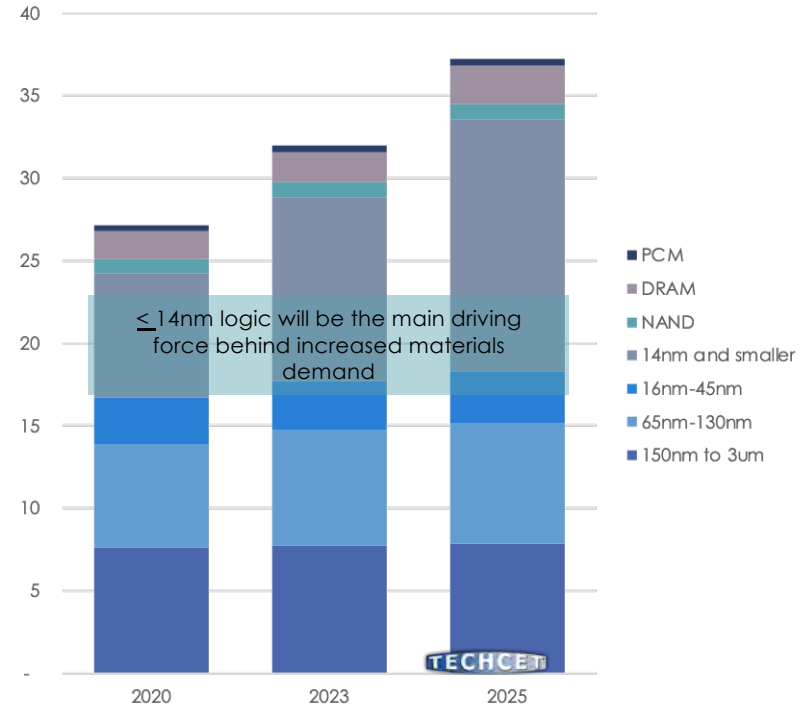
***Selected Chemical Volume Growth
2020-2025***

Chemical	Volume Growth, 2020 to 2025
H ₂ SO ₄	37 % Increase
NH ₄ OH	46 % Increase

ADVANCED DEVICES DRIVE MATERIALS INCREASES

- ▶ The main driving force for US materials demand increase will be 14nm and smaller devices.
- ▶ Not only will significantly larger quantities of bulk process chemicals be needed, but the required materials will also have to be of the highest purity with trace metal levels below 100 ppt.
- ▶ These estimates are derived from primary and secondary market research and TECHCET's proprietary wafer start model which focuses on device production by device type and node trends.

Figure 2: US Wafer Capacity Forecast 2020-2025 by Node



CAPACITY SHORTFALLS EXPECTED

- ▶ Domestic capacity is expected to increase slightly during the forecast period.
- ▶ These estimates assume a 2-3 year cycle time for new capacity.

Table 2: Capacity Shortfalls Expected

Process Chemical	Expected Shortfall 2025*			Comments
	Total	IC Grade	UHP Grade	
H2SO4	-9%	0%	-19%	These shortages take into account planned domestic production coming online within the next 1-3 years.
NH4OH	-18%	-3%	-35%	Relatively easy to manufacture from anhydrous NH4 and water, however there is a significant dependency on imports for UHP.

IMPORT DEPENDENCIES

- ▶ 14% of all US Semiconductor Bulk Chemicals are imported.
- ▶ The percentage of imports jumps to 31% when examining only UHP chemicals.
- ▶ TECHCET's estimates predict an increase in material cost due to freight.
- ▶ Using IPA as an example indicate ocean freight could add 16% to current prices.

Increasing Dependency of UHP Products on Imports 2020 vs. 2025 and IPA Shipping Cost Summary

Chemical	2020 % of UHP from Imports	2025 % of UHP from Imports
H2SO4	47%	43%
IPA	83%	100%
NH4OH	26%	32%

TEHCET IPA Shipping Cost Summary: 1MKg IPA*

Taiwan to Phoenix

\$0.43 per Kg cost

This is 16% of current ASP

*Includes amortization on container cost and 2020 transportation costs, see Section 6 details.

A POTENTIAL DISCONNECT:

“The chemical suppliers value doing business with us.” Senior Procurement Executive, IDM

“We’re a chemical company not a semiconductor materials supplier. We look at a product portfolio and make decisions based on margin dollars and ROI.” Senior Executive, Global Material Supplier

TEHCET's ASSESSMENT:

- ▶ Given the opportunity multiple chemical suppliers, both US and others, will be tempted to jump into the market.
- ▶ Geopolitical issues and supply chain problems developing in Europe add to the confusion.
- ▶ We see a high likelihood of tightening supply and price increase in the short (2-3 years) term.

UPCOMING EVENTS

OCTOBER 2021

CMC Members Only: F2F

- ▶ October: 19 & 20th CMC Fabs
- ▶ October 20th: Joint Session- CMC Fabs and CMC Associates – afternoon session
- ▶ Live and in person at
- ▶ ON Semiconductor Phoenix AZ



APRIL 2022

- ▶ Spring Conference April 27 & 28th, 2022
- ▶ F2F: April 25/26 2022
- ▶ Location: TBD (Phoenix)

NEW! IMPACT OF CHIP EXPANSION ON US CHEMICAL SUPPLY-CHAIN MARKET REPORT



- ▶ Actionable information for both device manufacturers and material suppliers identifying bulk process chemical issues in light of the ongoing US domestic fab expansion.
- ▶ Highlights capacity shortfalls by process chemical and purity level and details the current and projected reliance on imports.
- ▶ Outlines anticipated reactions to the expansion from both domestic and foreign suppliers of bulk process chemicals
- ▶ The Table of Contents:
<https://techcet.com/product/impact-of-chip-expansion-on-us-chemical-supply-chain/>
- ▶ **Please contact Diane Scott for more information at dscott@techcet.com**



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THANK YOU!

AUGUST 2021