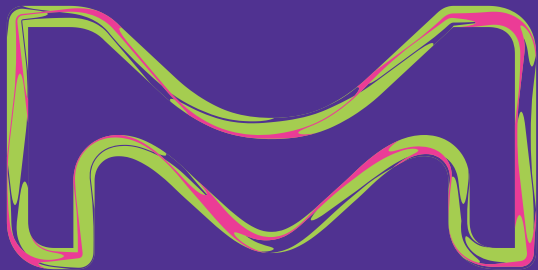




MERCK KGAA, DARMSTADT, GERMANY CITI GLOBAL TECHNOLOGY CONFERENCE

Anand Nambiar, Executive Vice President & Global Head of Semiconductor Solutions

New York – September 7, 2018





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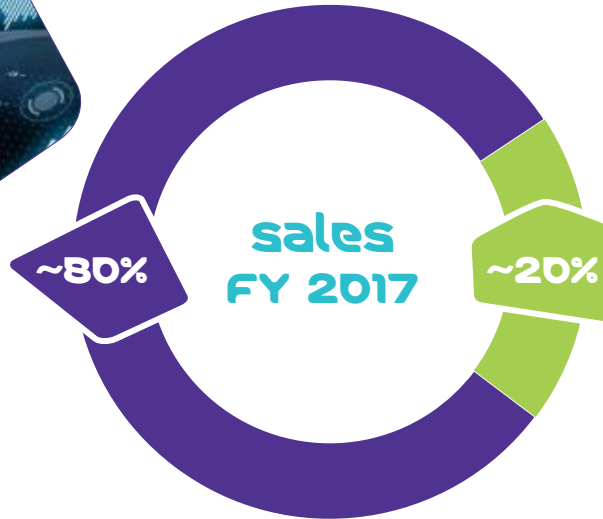
Performance Materials targets attractive markets – especially in the electronics space

Electronics Market



Market size:
~€1,250 bn
CAGR 18-25:
~4%

Performance Materials sales by end market



Automotive Market



Market size:
~€2,000 bn

- Driven by world GDP growth
- Increasing demand in emerging markets

Cosmetics Market



Market size:
~€400 bn

- Driven by world GDP growth
- Rising living standards and higher disposable income

- Driven by digital disruptions and megatrends such as digitalization
- Heterogeneous end-user applications
- Semiconductors as the engine of all electronic systems

Source: McClean 2018/IC Insights 2017, Gartner 2017, Prismark 2018, Statista 2016
Abbreviation: CAGR = Compound annual growth rate; GDP = Gross domestic product

Performance Materials

A leader in the electronic materials market

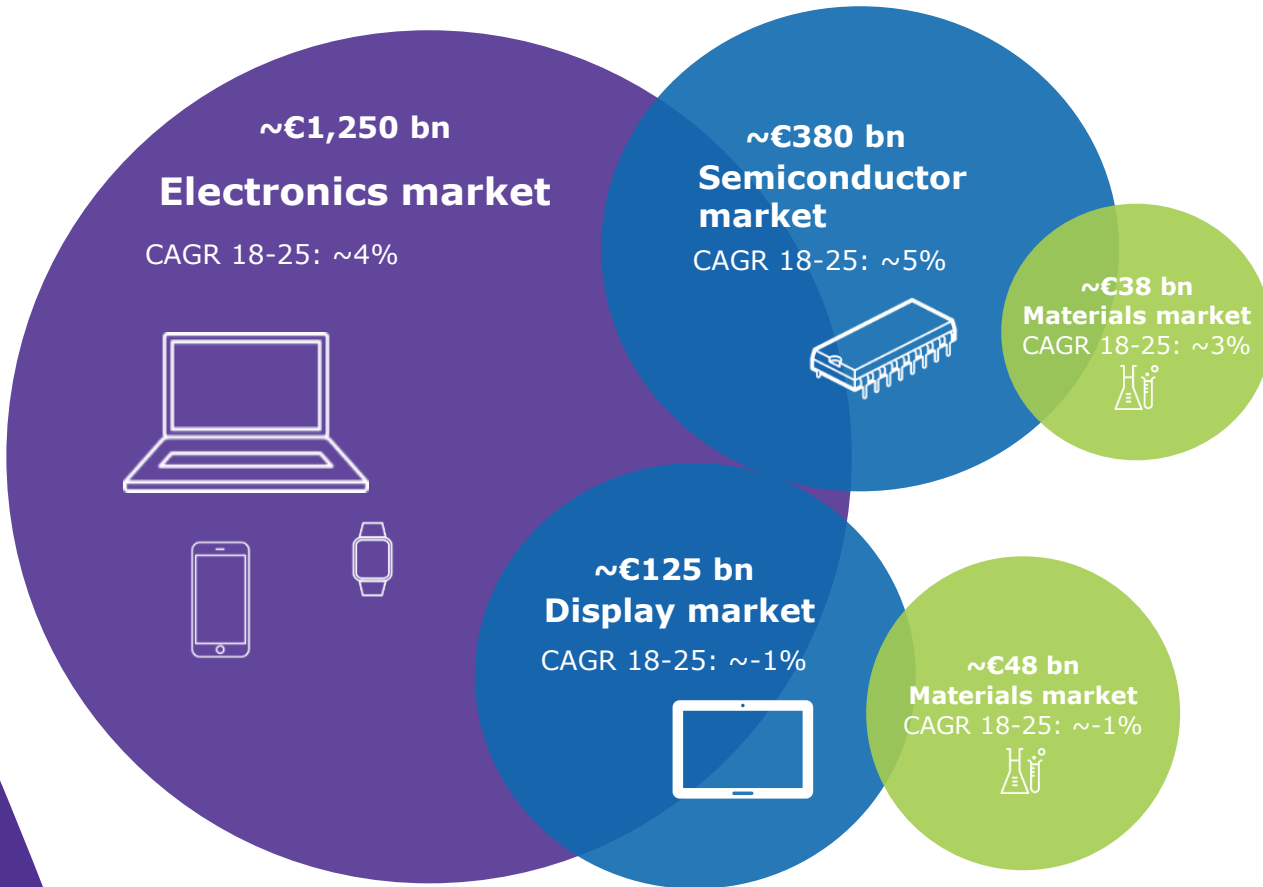
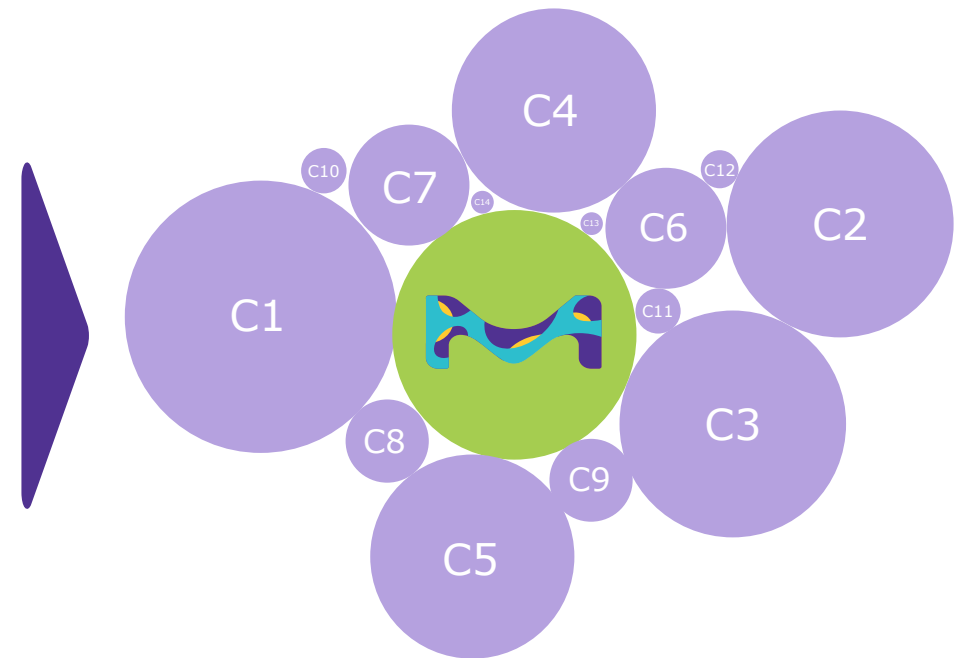


Illustration of the electronics market and thereof its selected sub markets

Electronic materials competitor landscape¹



¹Bubble size in competitive landscape illustrates share of semiconductor and display material sales of indicated competitors (C1 – C14)

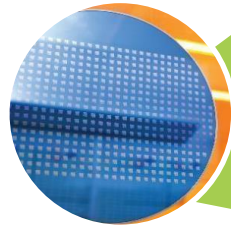
Performance Materials

Three pillars are set for future profitable growth

% sales

Products

Today's
FOCUS



semiconductor
solutions



- Dielectrics, colloidal silica, lithography materials, yield enhancers, edge-bead removers
- Polyimide raw materials and printing materials



display
solutions



- Liquid crystals (LC) and photoresists for TVs, smartphones and tablet computers
- Other display and non-display applications (e.g. LC Windows)
- Organic light emitting diodes



surface
solutions



- Effect pigments and functional materials for coatings, plastics, printing and cosmetics
- Functional solutions for cosmetics & special applications
- Functional solutions for electronics and energy solutions

Semiconductor Solutions products - key enabler for digital trends

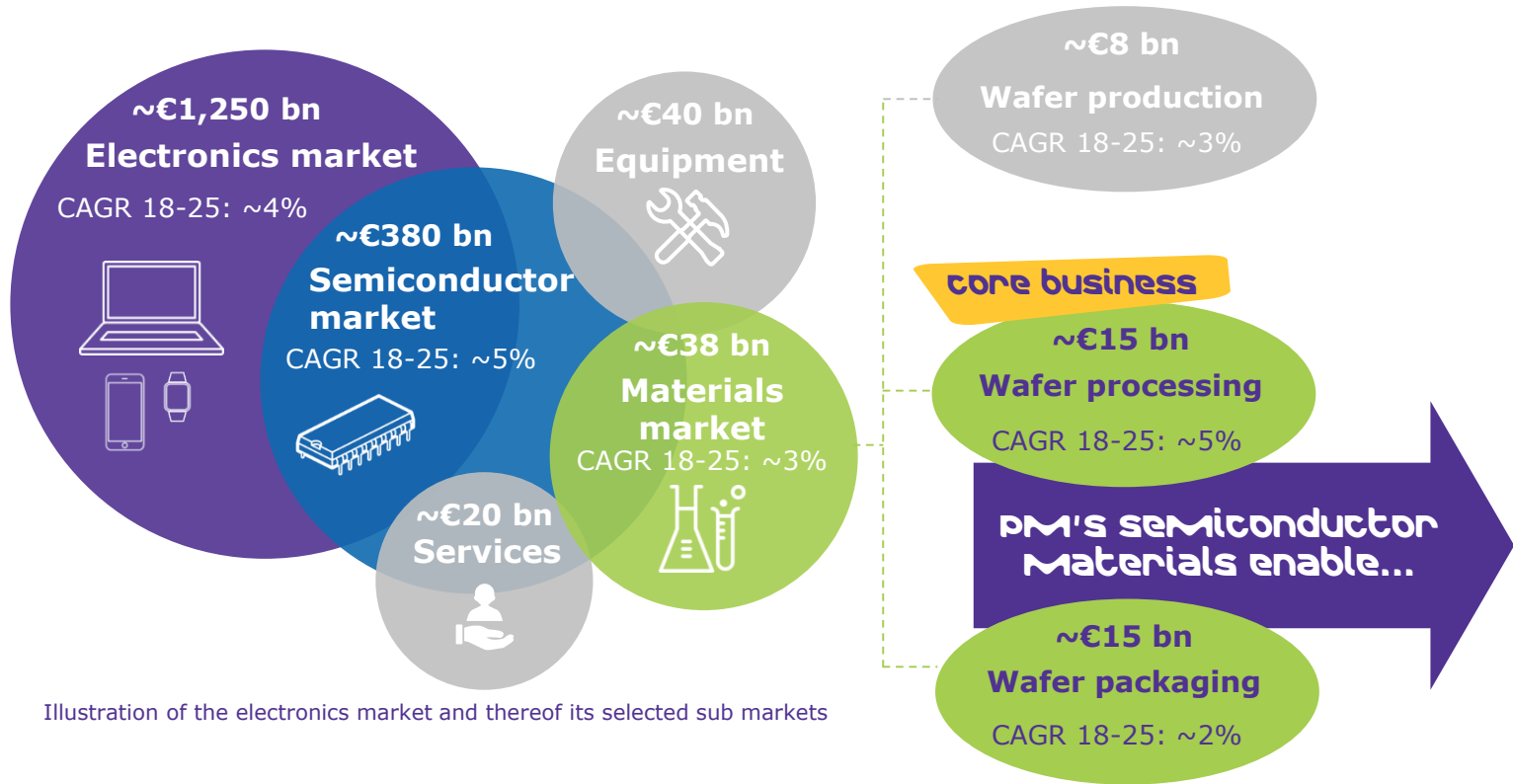


Illustration of the electronics market and thereof its selected sub markets

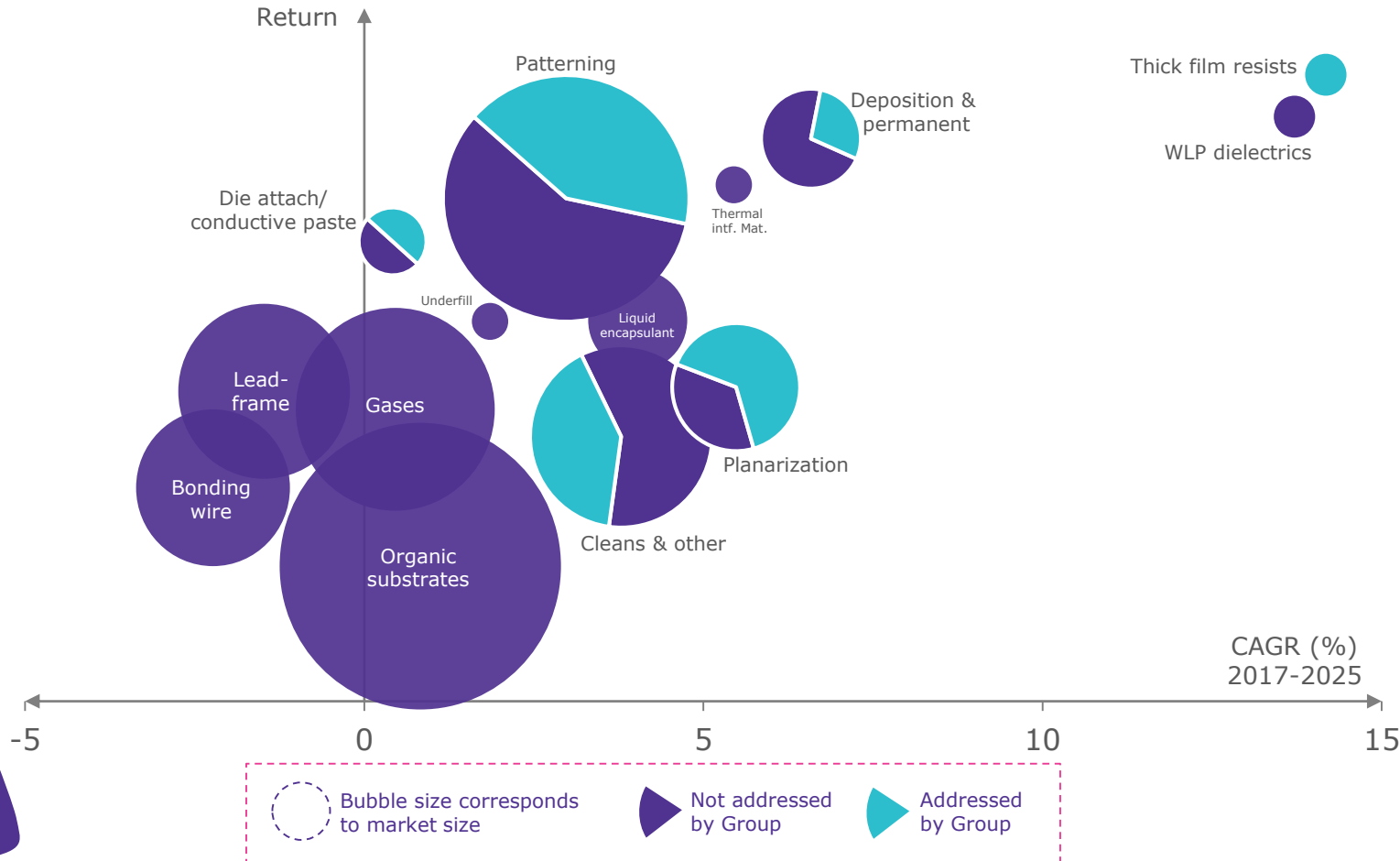
...customer needs

- Smaller structures beyond limitations of existing technologies
- Higher memory capacity, faster processing speed, less power consumption
- Improved yield and lower processing costs

Performance enhancing materials will benefit over-proportionately from attractive semiconductor growth rate of 5% CAGR

Semiconductor Solutions is well positioned in highly attractive market segments

Market landscape of wafer processing and packaging materials

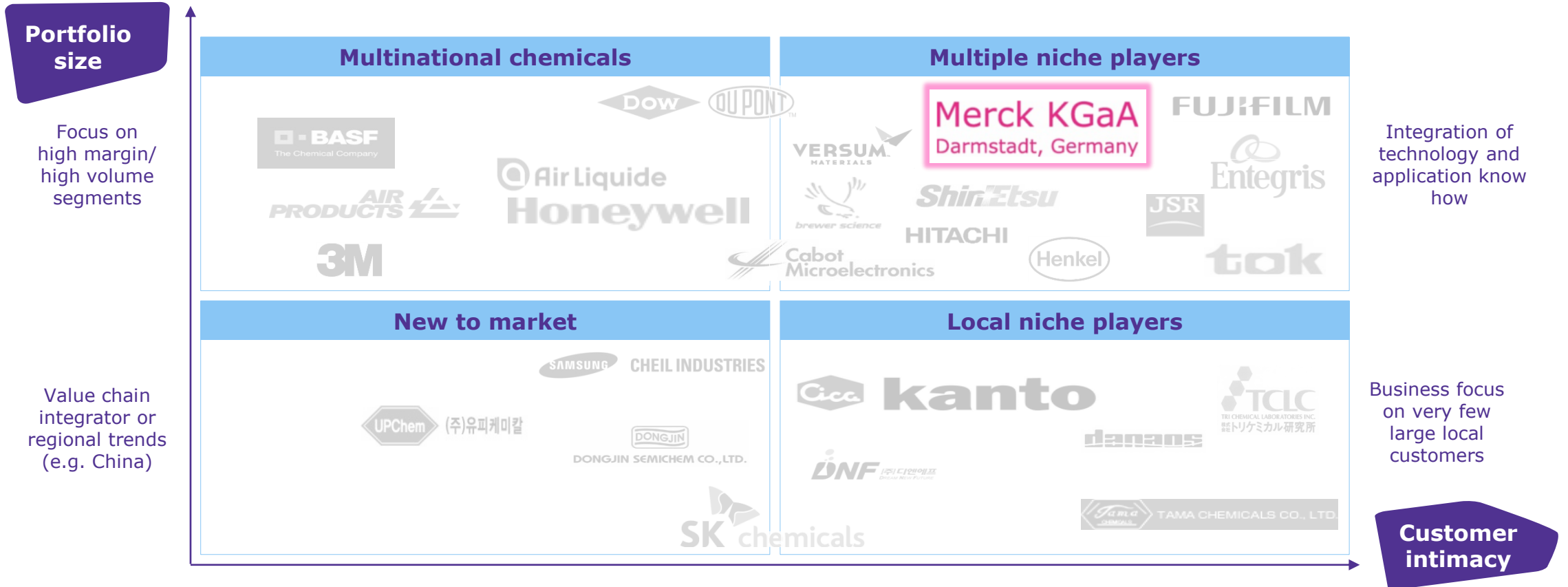


Market positioning

- Positioned in attractive sub-segments
- Focus on enabling material solutions with small part in bill of materials
- Address innovative technologies through collaborative R&D
- Above-market growth
- Opportunities to increase footprint

Illustration;
Abbreviation: WLP Dielectrics = Wafer Level Packaging Dielectrics

Semiconductor Solutions faces four types of competitors in market



Solution provider in attractive niches – within these niches, number and size of competitors vary a lot, which creates a large competitor landscape

Semiconductor Solutions is market-leader in crucial areas

Market requirements



customer intimacy



solutions



speed



quality

semiconductor solutions

- >30 years of experience
- Strategic partnerships
- Dedicated KAM
- Preferred partner for tool manufacturers

- Enabling solutions for smaller structures and 3D chip architecture
- Material pipeline filled with customer-relevant ideas
- Close cooperation and technical support

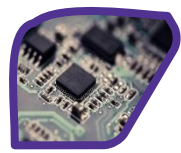
- First mover strategy for leading edge accounts
- Strong focus on customer-centric product life cycle management

- Proven track record of reliability
- Local support centers
- Deep understanding of critical production processes

Leading market positions



Deposition
#1 market leader



Spin-on dielectrics
#1 market leader



CMP Slurries
Top 3¹

Abbreviation: KAM = Key Account Management, CMP = Chemical Mechanical Planarization;
¹Corresponds to Merck KGaA, Darmstadt, Germany joint business with partners

Competitive strengths



Technology & Innovation

- Development of highly innovative materials enabling new processes & better products for our customers (e.g. SOD, Shrink, DSA, Conductive pastes, etc.)
- Strong IP position in BARC, Shrink & SOD
- Excellent manufacturing know-how (e.g. Photoresists, SOD)
- Solution provider beyond a material supplier through strong partnership with leading equipment makers
- Covering regulatory & green aspects (Conductive Pastes, Process Materials)



Market & Customer intimacy

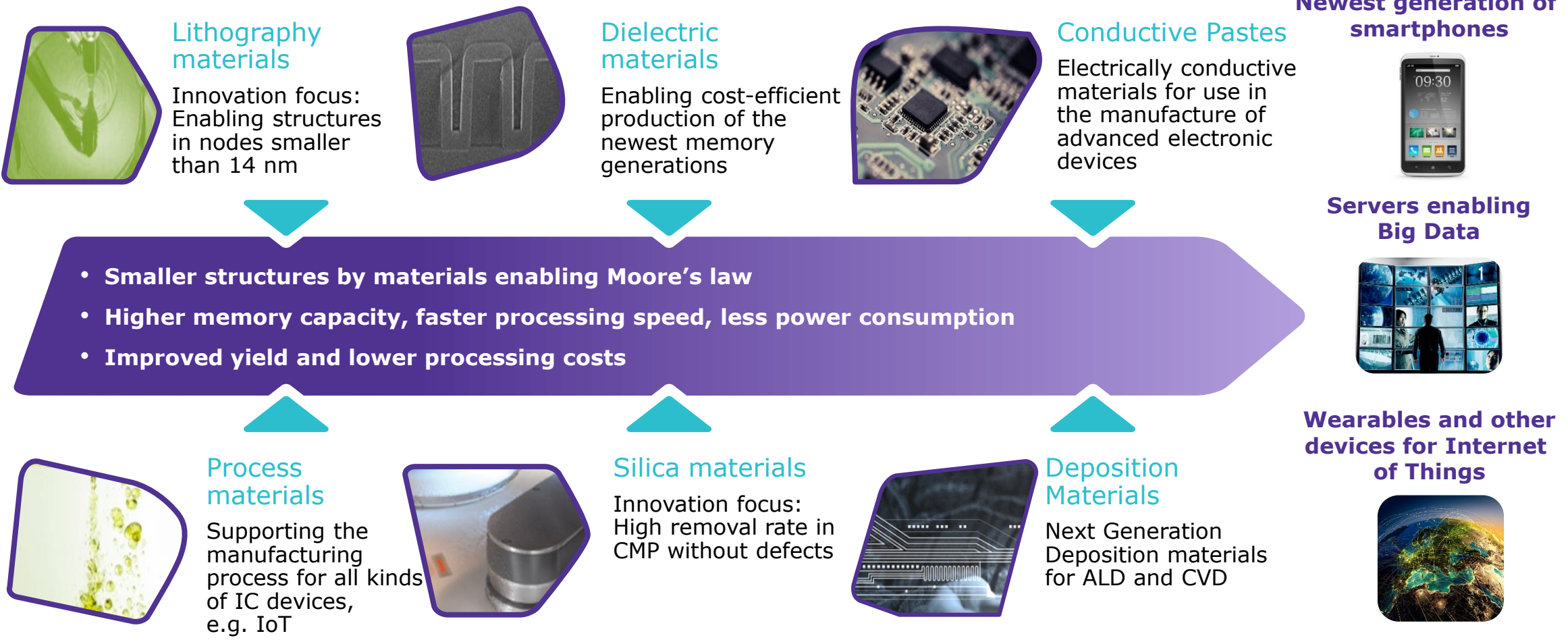
- Market leader in selected areas (SOD, Shrink, Rinse, TARC)
- Strong customer focus & strategic partnership with key players
- Long-time engagement with customers & close collaboration
- Established reputation & trust
- Dedicated Account Management, also for non-Leading Edge customers – Packaging & Specialty accounts
- Availability of strong technical services/support



Supply & Infrastructure

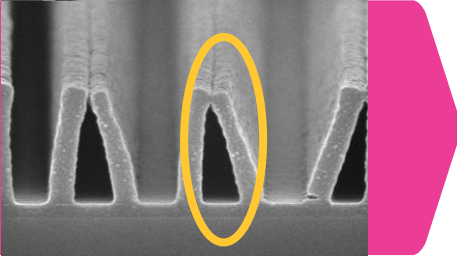
- Outstanding quality systems (e.g. SOD) and particle quality (Klebosol)
- Flexible production capacities to fulfil customer requirements
- Vertically integrated supply chain (Packaging, Deposition, SOD)
- Expertise in handling of air sensitive and pyrophoric materials in deposition area
- Business Continuity Plan for core products to eliminate supply risk
- Strong manufacturing & regulatory know-how

Enabler of key technology trends

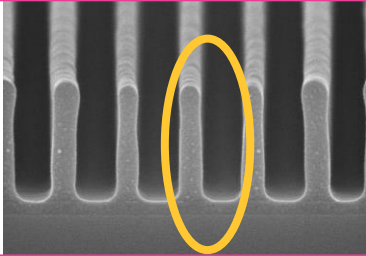


Semiconductor Solutions develops dedicated solutions for customer challenges, enabling cutting edge innovation

Pattern collapse

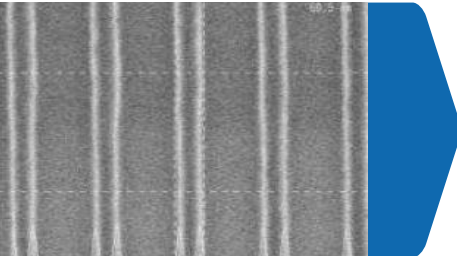


Firm[®] rinse materials




- As lines get narrower and closer together in advanced chip generation, they tend to “stick” due to surface tension.

Lithography limitation

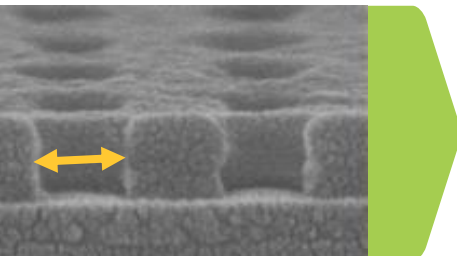


Directed self assembly (DSA)

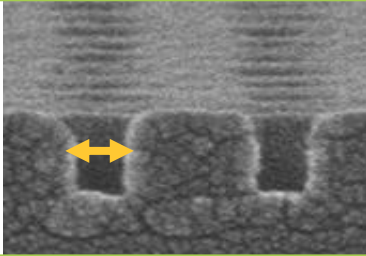


- Block Copolymer can generate small lines or contact holes by self-assembly. This allows miniaturization without expensive new equipment.

Wide features



Relacs[®] shrink materials



- Shrink materials “shrink” the gap between lines and, hence, allow the manufacture of narrower features otherwise not possible

Overcoming technology barriers – supporting continued progression of technological mega trends

Market drivers and technological trends

Miniaturization: Devices are becoming smaller with better performance

- Need for enabling materials to reduce size (Moore's law)

Mobility: Everyone is continuously connected without direct power supply

- More chips needed for local energy production
- Energy storage → smaller batteries with higher density

Internet of Things: Everything is continuously connected

- More gadgets and devices that include chips
- Increasing amount of communication and sensor chips

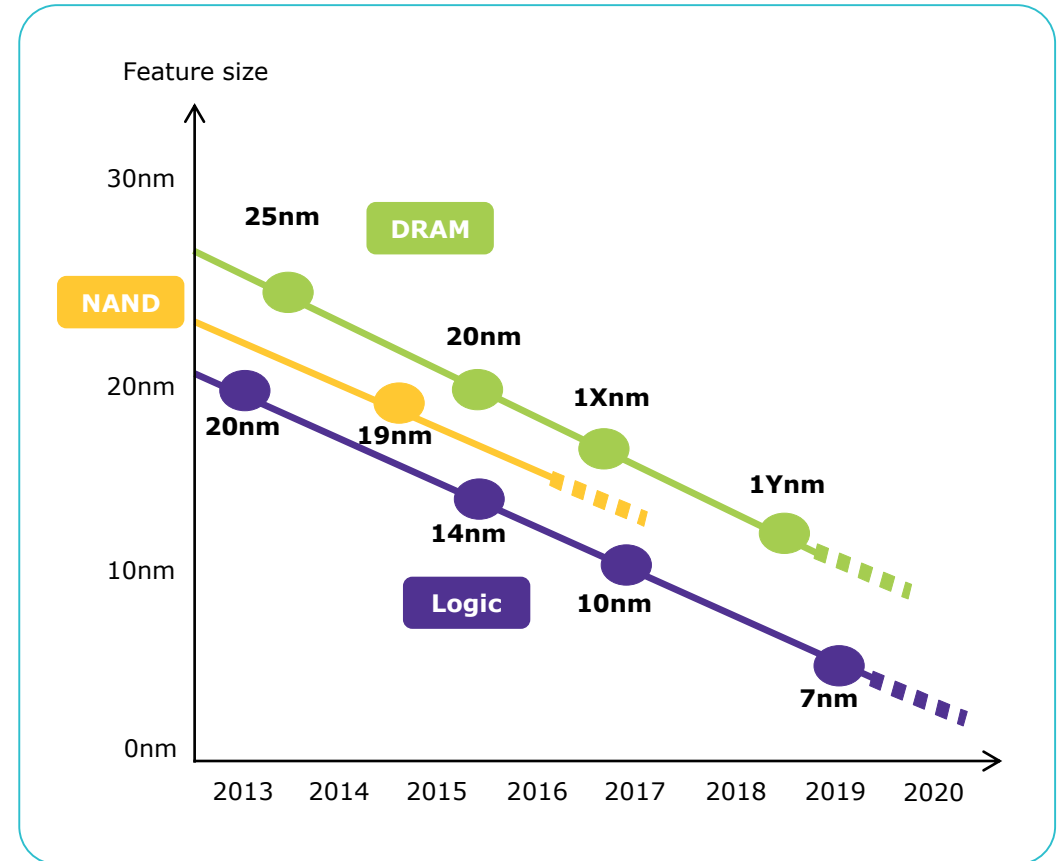
Big Data: Increasing need for intelligent data storage

- Switch from hard disk drives (HDD) to solid state drives (SSD)

Selected competitors

- Tokyo Ohka Kogyo
- Dow Electronic Materials
- Nissan Chemicals
- JSR

Feature sizes develop as predicted by Moore's law



Market & Customer Intimacy

Global Footprint

 R&D  Production



Haverhill, MA, US



Branchburg, NJ, US



Wiesbaden, Germany





Ansung, Korea





Shizuoka, Japan



San Diego, CA, US



Martin, SC, US





(IMEC) Leuven, Belgium






Suzhou, China





Hsinchu, Taiwan





Sheboygan, WI, US



Lamotte, France



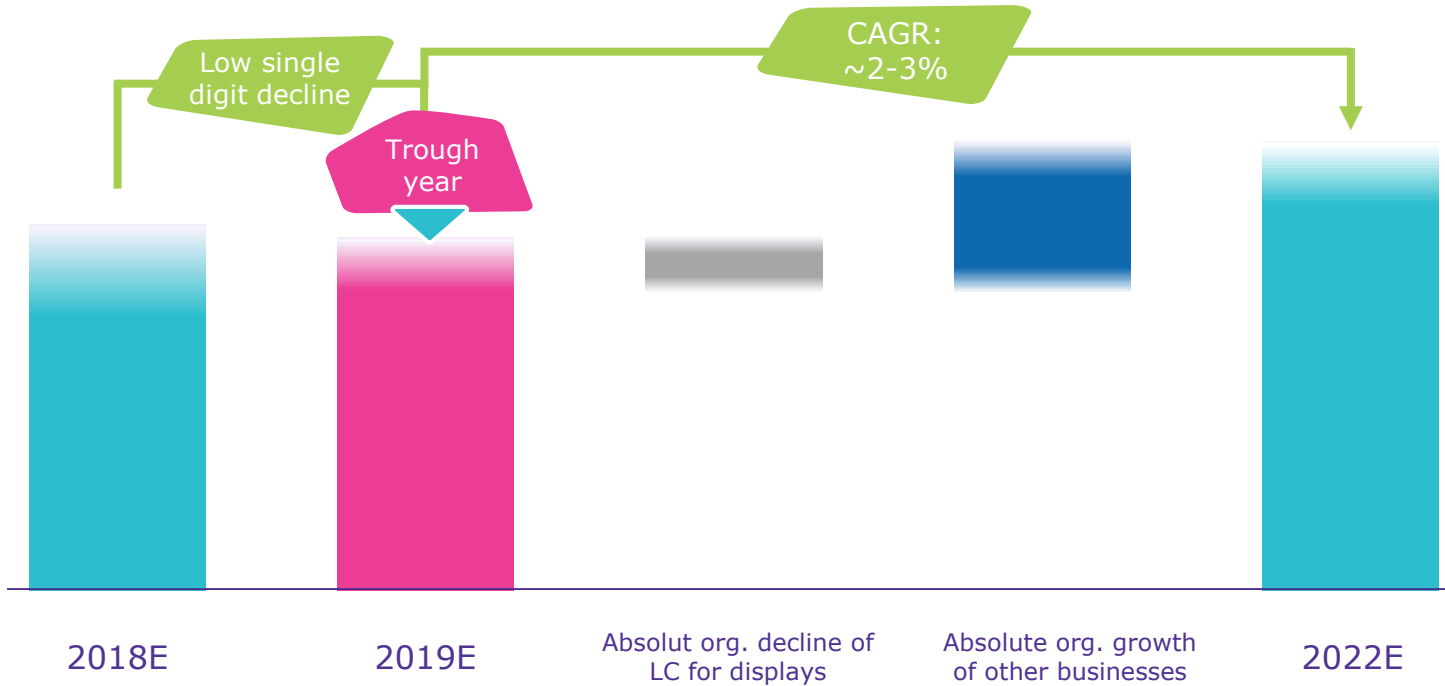
Kaohsiung, Taiwan

Performance Materials

Performance Materials will return to sales growth after 2019

Performance Materials sales development, in €m



2019-2022 sales growth trajectory

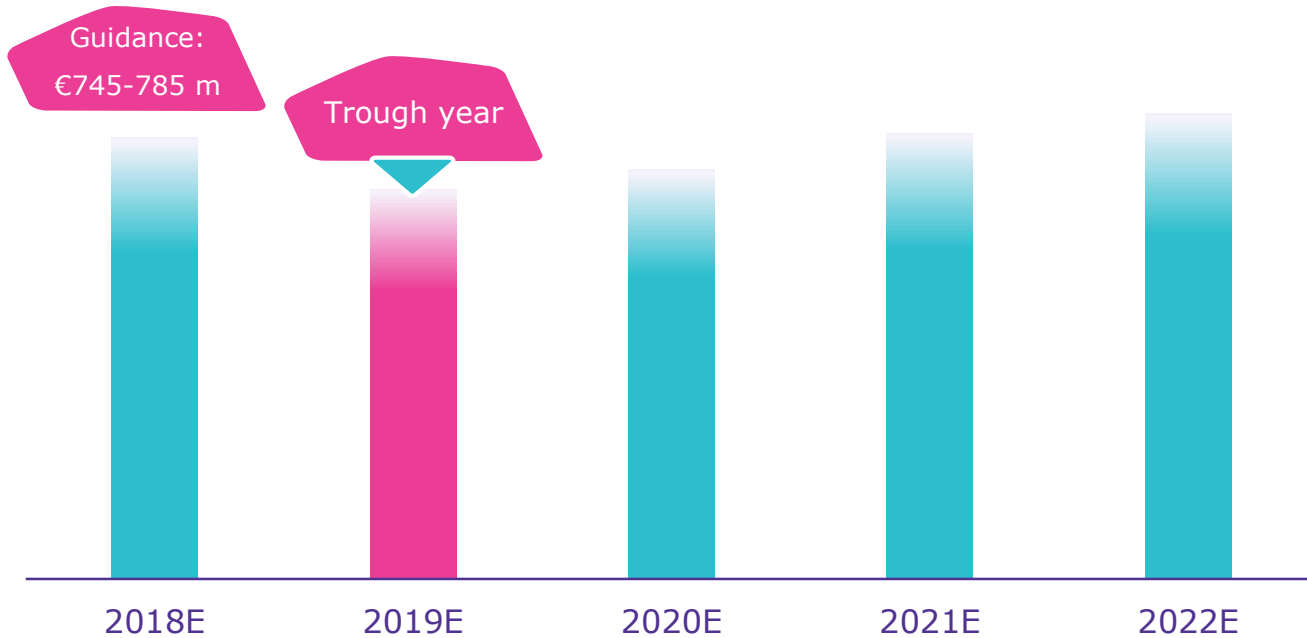


After 2019 sales growth of Semiconductor & Surface Solutions, OLED and Photoresists will overcompensate the decline of Liquid Crystals for displays

Performance Materials

Positive sales development drives earnings growth after 2019

EBITDA pre development



EBITDA pre development

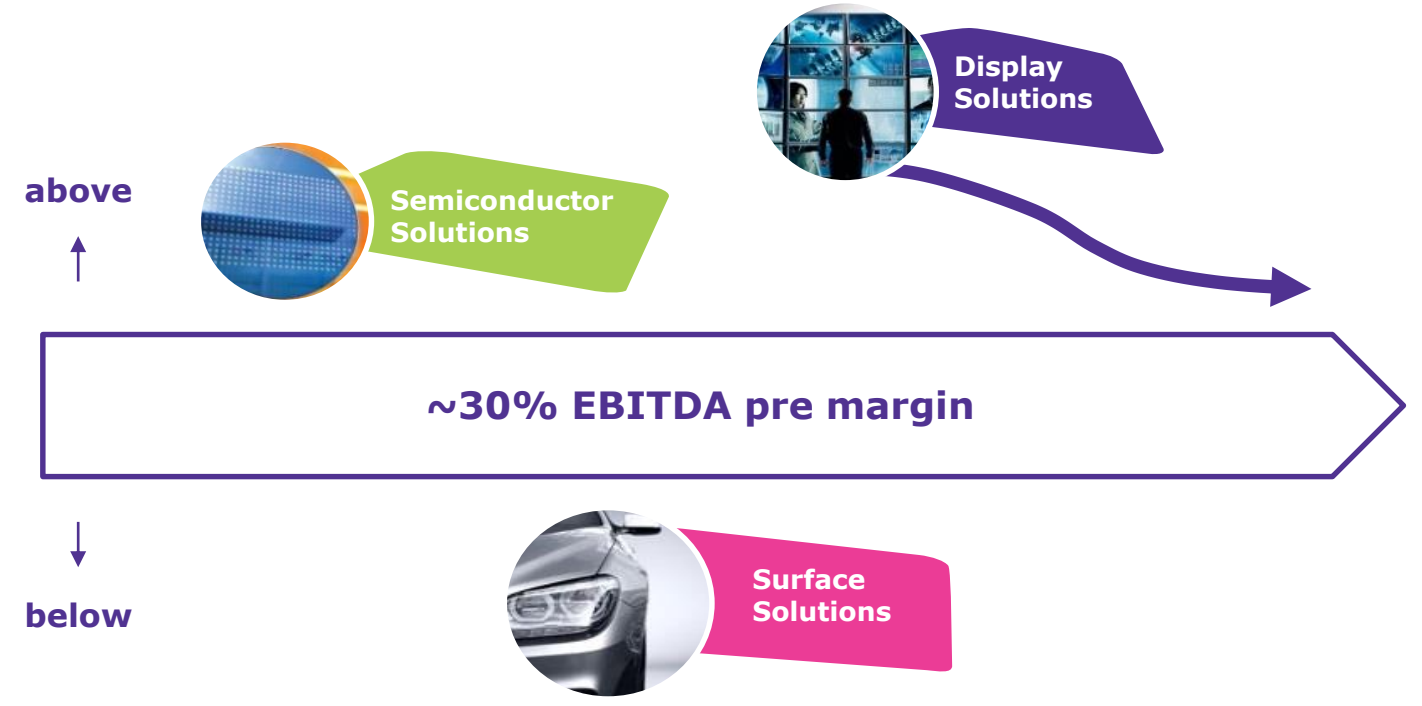
- After 2019, EBITDA pre will grow due to positive sales development
- Semiconductor & Surface Solutions will overcompensate for Display Solutions EBITDA decline after 2019

Performance Materials Margins of PM will remain around 30% in the long-run

profitability indication

- Display Solutions will adjust towards PM average margin
- Bottom-line management to support margin
- Strong FX exposure will cause fluctuations

EBITDA pre margin indication by business



Executive summary



Semiconductor Solutions is a key enabler for digital trends



Long-term sales growth projected in the mid to high single digits



Solution provider in highly attractive market segments



Highly valuable pillar within Performance Materials



The background features a solid light green field on the right side, which transitions into a series of overlapping, rounded, organic shapes in shades of purple and pink on the left side. The shapes are layered, with some appearing in front of others, creating a sense of depth and movement.

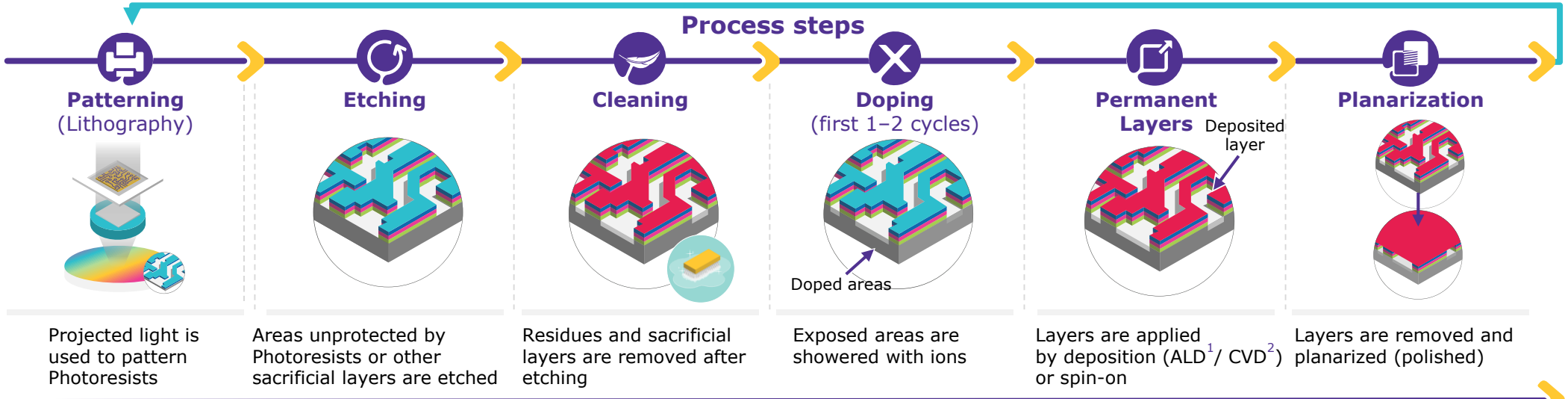
back-up

Detailed Wafer processing steps

>10 cycles

Process steps

Processing steps



Our offering

- Broad range of products on BARC, TARC, Shrink & Rinse materials
- Thick film photoresist for multiple generations of lithography technology
- Innovative patterning technologies/materials under development, incl. DSA, MHM

- Wide portfolio of high purity wet chemicals
- Covering Edge Bead Removers, Strippers, Developers and Photo ancillaries

- Inorganic & organic SOD materials enhance device performance with excellent gap-filling & superior defectivity performance
- Rich portfolio of high purity metal & dielectric precursors empower FEOL & BEOL applications for advanced logic & memory devices

- Klebosol is a leading brand of multipurpose colloidal silica, with applications in diverse industries ranging from beverages to electronics

Our semiconductor products enable entire wafer chip production

¹Atomic layer deposition; ²Chemical Vapor Deposition

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