Challenges for Semiconductor Materials Cleans Suppliers

Agenda

- Merger overview
- Key Challenges of Cleans Supplier
- Solutions and capabilities to compete
- Case studies

Three Leading Growth Divisions Launched from Industry-defining Transaction

Portfolio re-alignment driven by *growth* rationale in every case:

- Unique transaction – combines best capabilities of two industry leaders to create three strong companies, each with enviable competitive positioning and each with a distinct, compelling investment thesis
- Enhances alignment from the market back through vertical integration plus innovation capabilities in strategic value chains
- Each new division and future independent Company is significantly better positioned for future growth while cost synergy target remains consistent at $3.3 billion

>300 year combined history of science & innovation creates formidable industry leaders equipped to grow

Notes:
- *Materials Science: Includes silicones net sales and EBITDA for FY16;*
- *Specialty Products: Net sales include FMC H&N acquisition; expected to be completed in Nov 2017*
- *Agriculture: Excludes net sales and operating EBITDA associated with remedy transactions.*
- *Operating EBITDA is defined as income from continuing operations, net of tax excluding depreciation and amortization, interest income, interest expense and amortization of debt discount, taxes, and significant items*

DOWDUPONT ANNOUNCES BRAND NAMES FOR THE THREE INDEPENDENT COMPANIES IT INTENDS TO CREATE

- Agriculture Division to be Corteva Agriscience™, reflecting its purpose of enriching the lives of those who produce and consume ~$14B revenue 2017

- Materials Science Division will be called Dow, and will retain the Dow diamond as its brand, building on the Company's globally recognized 121-year history of innovation and value creation ~$44B revenue 2017

- Specialty Products Division to be the new DuPont, carrying forward a 215-year legacy of science-based innovation to transform industries and everyday life ~ $21B revenue 2017

Specialty Products: Powerful Combination of Highly Differentiated, Innovation-Driven Segments

Electronics & Imaging

World's largest supplier with the broadest set of materials and technologies to solve complex problems for the semiconductor, circuit board, photovoltaic, display and digital printing industries.

Transportation & Advanced Polymers

Industry leader providing high-performance engineering resins, adhesives, lubricants and parts to engineers and designers in the transportation, electronics and medical markets.

Safety & Construction

Global leader in branded products including fibers and foams, aramid papers, non-wovens, membranes and protective garments serving the construction, oil & gas, energy, worker safety and transportation markets.

Nutrition & Biosciences

Industry leader in bio-based ingredients and a biosciences pioneer serving the food, nutrition, pharma, home and personal care, bio fuels and animal nutrition markets with healthier and more sustainable offerings.

Market Insights & Customer Intimacy

Technology & Innovation Edge

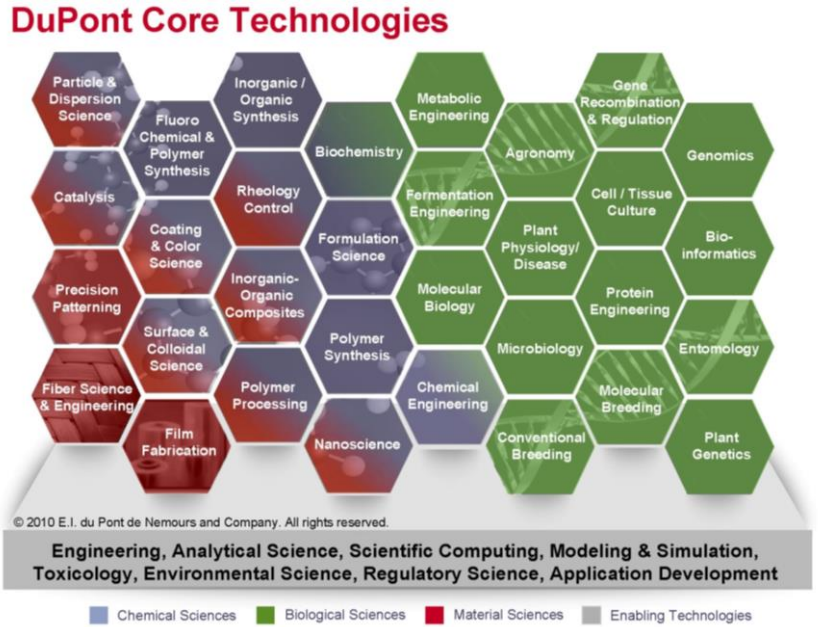
Differentiation & Market Leadership

$200MM Investment in Experimental Station on Collaboration and Incubation

DowDuPont is positioned to innovate:

Leveraged Competencies:

- **Organic chemistry**
- **Fluorochemistry**
- **Polymer synthesis, processing, and characterization**
- **Chemical engineering fundamentals**
- **Process development and scale-up**
- **Inorganic chemistry**
- **Materials science**
- Fiber science and engineering
- **Organometallic chemistry**
- **Nanomolecule manipulation**
- Materials optics
- Precision patterning
- **Dispersion science**



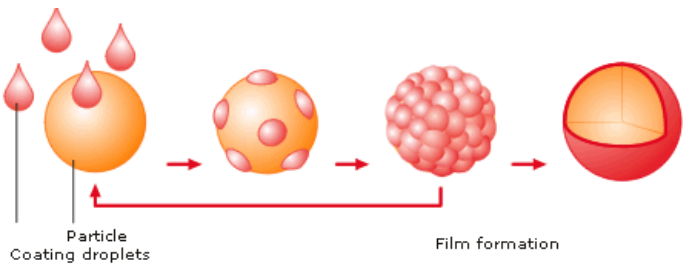
https://www.delawareonline.com/story/news/2017/01/09/breen-dupont-invest-200m-experimental-station/96372908/

Engineering Research & Technology

Competencies:

- **Product Design & Development**
  - Engineering Mechanics
  - Mechanical Systems Design & Development
  - Particle Processing, Surface Science
- **Process Engineering**
  - Advanced Modeling Technologies
  - Materials Engineering
  - Polymers, Dispersions & Interfaces
  - Process Dynamics & Control
  - Measurement Systems Technology
  - Reaction Engineering
  - Heat, Mass & Momentum Transfer
  - Agitation: Mixing, Fluid Flow
  - Thermodynamics
  - Engineering Evaluations
  - Purification
- **Safety, Health & Environment**
  - Environmental Engineering
  - Process Safety & Fire Protection
  - Explosion Hazards Lab
  - Sustainability
- **Operations/Support**
  - Energy Engineering
  - Mechanical Systems
  - Rotating Machinery
  - Operations Modeling
  - Applied Statistics

Particle Engineering –
Formation, Coating, and Surface Modification



The New Electronics & Imaging Business

Introducing a $5B technology leader with a unique depth and breadth of knowledge, applications and technical expertise, and product portfolio to address customers' needs.

Serving the semiconductor, advanced chip packaging, circuit board, electronic and industrial finishing, photovoltaic, display, and digital and flexographic printing industries.

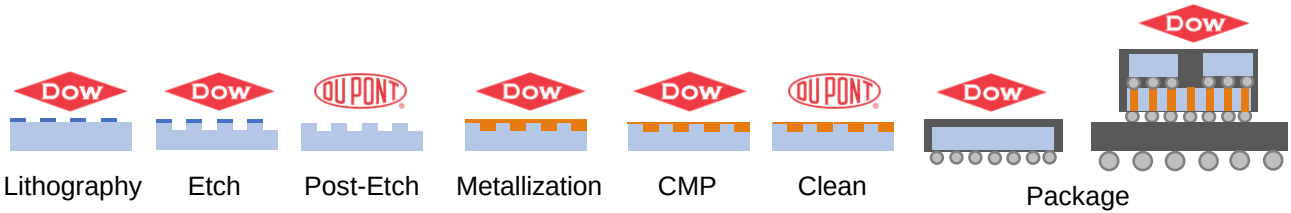
Electronics & Imaging Business Overview

	DOW	DUPONT
 **Semiconductor Technologies**	✔ CMP pads and slurries ✔ Photolithography materials ✔ Advanced packaging materials	✔ Removers and cleaners
 **Circuit & Industrial Technologies**	✔ Metallization materials ✔ Imaging materials ✔ Surface finishes	✔ Polyimide films and laminates ✔ Dry film photoresists
 **Photovoltaic and Advanced Materials**		✔ PV metallization pastes ✔ Thick film pastes ✔ Polyvinyl fluoromaterials
 **Advanced Printing**		✔ Flexographic plates and materials ✔ Digital inks
 **Display Technologies**	✔ OLED materials ✔ Cadmium-free quantum dot materials ✔ Display process chemicals	✔ OLED materials ✔ Display enhancements

Not shown:
Silicones for industrial lighting, semiconductors, electronics and other applications
Trichlorosilane for polysilicon wafer production
Hitachi DuPont Microsystems, stress buffers and dielectric materials

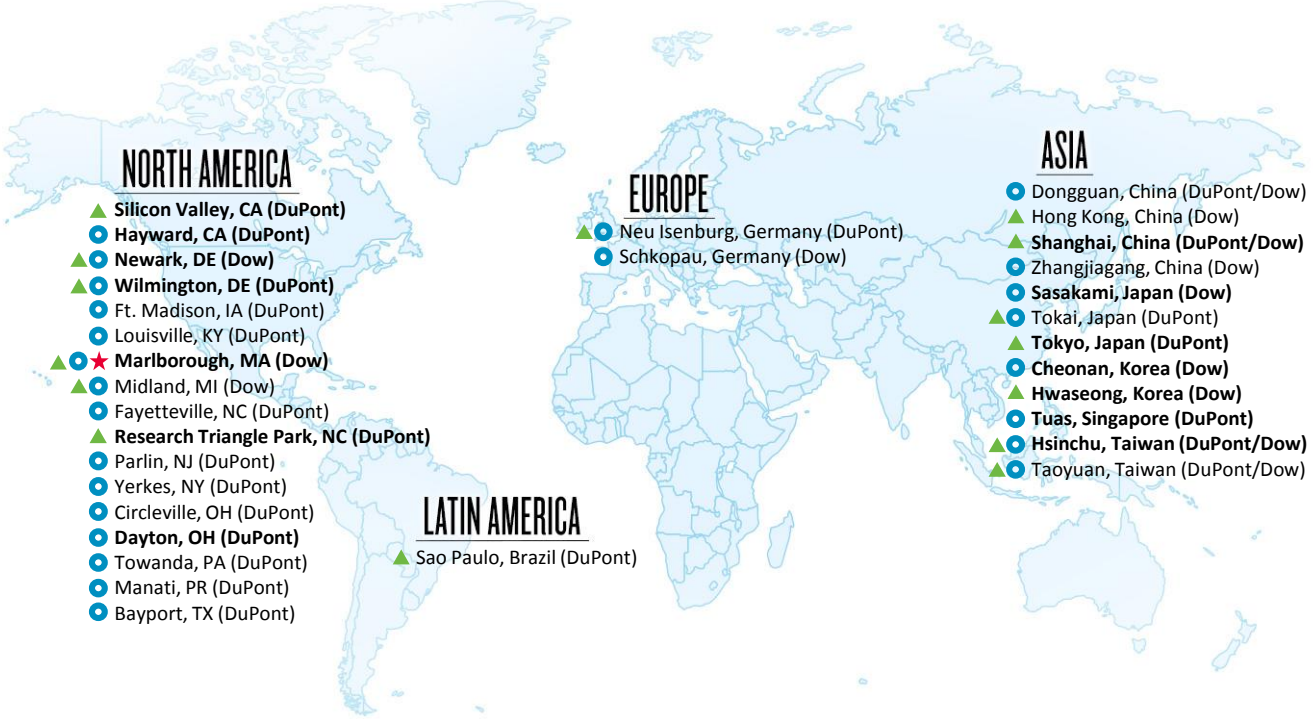
Semiconductor Technologies

- Expanded portfolio of materials to serve the semiconductor industry
- Greater depth and breadth of expertise for today's advanced challenges
- Streamlined infrastructure and processes



Leverage business synergies to drive success in innovation and commercialization

Our Global Reach



NORTH AMERICA

- **Silicon Valley, CA (DuPont)**
- **Hayward, CA (DuPont)**
- **Newark, DE (Dow)**
- **Wilmington, DE (DuPont)**
- Ft. Madison, IA (DuPont)
- Louisville, KY (DuPont)
- **Marlborough, MA (Dow)**
- Midland, MI (Dow)
- Fayetteville, NC (DuPont)
- **Research Triangle Park, NC (DuPont)**
- Parlin, NJ (DuPont)
- Yerkes, NY (DuPont)
- Circleville, OH (DuPont)
- **Dayton, OH (DuPont)**
- Towanda, PA (DuPont)
- Manati, PR (DuPont)
- Bayport, TX (DuPont)

EUROPE

- Neu Isenburg, Germany (DuPont)
- Schkopau, Germany (Dow)

LATIN AMERICA

- Sao Paulo, Brazil (DuPont)

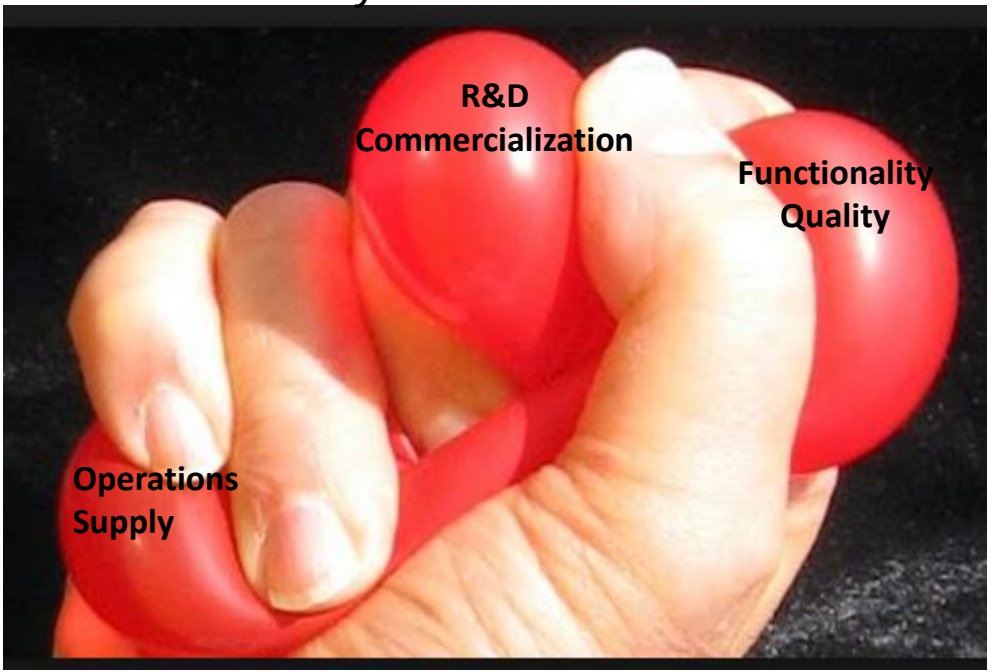
ASIA

- Dongguan, China (DuPont/Dow)
- Hong Kong, China (Dow)
- **Shanghai, China (DuPont/Dow)**
- Zhangjiagang, China (Dow)
- **Sasakami, Japan (Dow)**
- Tokai, Japan (DuPont)
- **Tokyo, Japan (DuPont)**
- **Cheonan, Korea (Dow)**
- **Hwaseong, Korea (Dow)**
- **Tuas, Singapore (DuPont)**
- **Hsinchu, Taiwan (DuPont/Dow)**
- Taoyuan, Taiwan (DuPont/Dow)

★ Headquarters
Manufacturing
▲ Regional Technology Center

Note: Excludes offices, joint venture and partner sites.

“Squeezing the Balloon” - Control of Materials into the Semiconductor Industry



- Accurate measurement, control and continuous improvement are critical in the industry.
- Robust processes and systems are essential components in addressing materials supply challenges.

Operational Discipline

[Deeply rooted dedication and commitment by every person to carry out each task the right way every time.]

Organizations that have a high level of operating discipline, exhibit an identifiable set of characteristics.

Organizational Characteristics

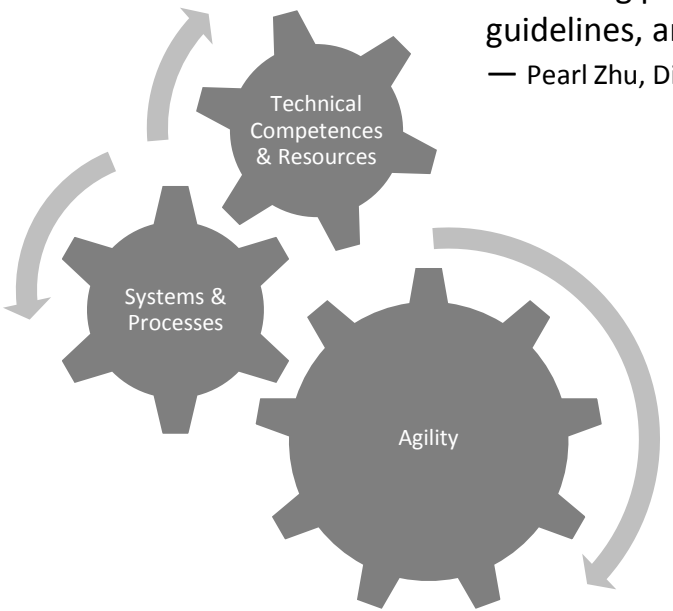
- *Leadership by example*
- *Sufficient & capable resources*
- *Employee involvement*
- *Active lines of communication*
- *Strong teamwork*
- *Shared values*
- *Up-to-date documentation*
- *Practice consistent with procedures*
- *Absence of shortcuts*
- *Excellent housekeeping*
- *Pride in the organization*
- *Quality Mindset at every level*

Operational Discipline is a key competence within DowDuPont

Operational Discipline **and** Agility are critical success factors in Semiconductor Market

"Agility should not be translated to sacrificing planning, management guidelines, and quality assurance."

— Pearl Zhu, Digital Agility



Supply & Operations Challenges

Raw Materials

- **Product Stewardship / Safety**
- **Availability of reliable sources**
- **E-grade purity capabilities**
- **Specifications / control limits**
- Low volume requirement vs. alternative markets
- Process change aligned with semiconductor requirements
- Regulatory changes

Product

- **Product Stewardship / Safety**
- Demand visibility
- **Ship to Control limits**
- **SPC / SQC correlation with device functionality and root cause analysis**
- Process change requirements
- **Measurement capability**
- Regulatory changes

R&D / Commercialization

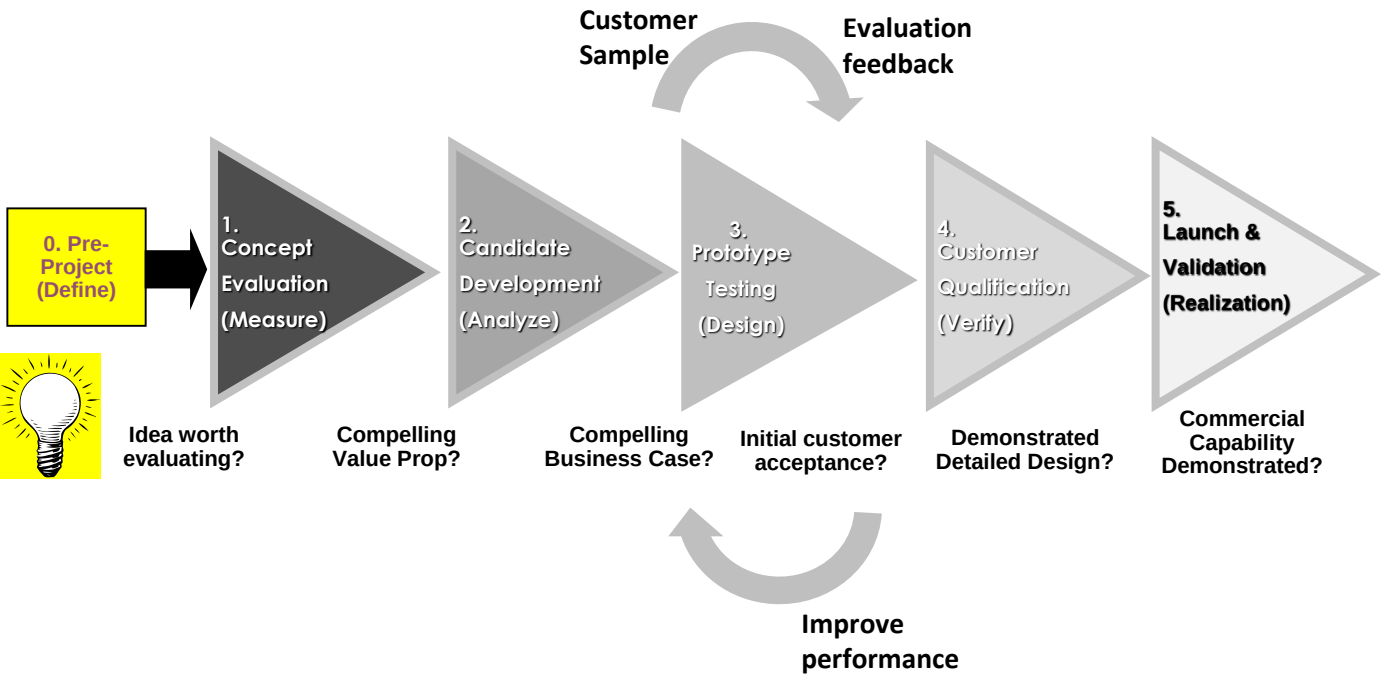
R&D

- **Customer requirements often a moving target**
- **Product performance feedback insufficient to make informed formulation adjustment**
- **Limited sample testing opportunities at customers**
- **Data driven selling process – gap btw. what we can test vs. customer widening**

Commercialization

- **Rapid scale up of Process-of-Record formulation**
- **Control limits CIP (continuous improvement) from previous technology node**
- Process change requirements
- Demand visibility

Product Commercialization Framework



- Engages whole organisation in management lead stage gated process.
- Customer collaboration integral part of process.
- Customer qualification ultimate gate to commercialisation of a new product.

Agility - Building Analytical Sciences Capability within E&I

- Driving fundamental insight through advanced analytic methodologies
- 3 core competencies: chemical, surface & electrochemistry analysis
- Strengthening method development expertise for formulation development and screening

Chromatography and Mass Analysis

HPLC-MS, *HR-LC-MS, IC, IC-MS, GPC, SEC, ICP-MS, Pyrolysis-GC-MS, Pyrolysis-GC-QToF, *Maldi-ToF, Karl-Fisher meter, Centrifuge, Rotary-Evaporator, Lyophilizer, TGA, *NMR, Microwave

Electrochemistry Analysis

Solatron Echem. PMC Echem, Autotitrator, GM system, Haring Cell

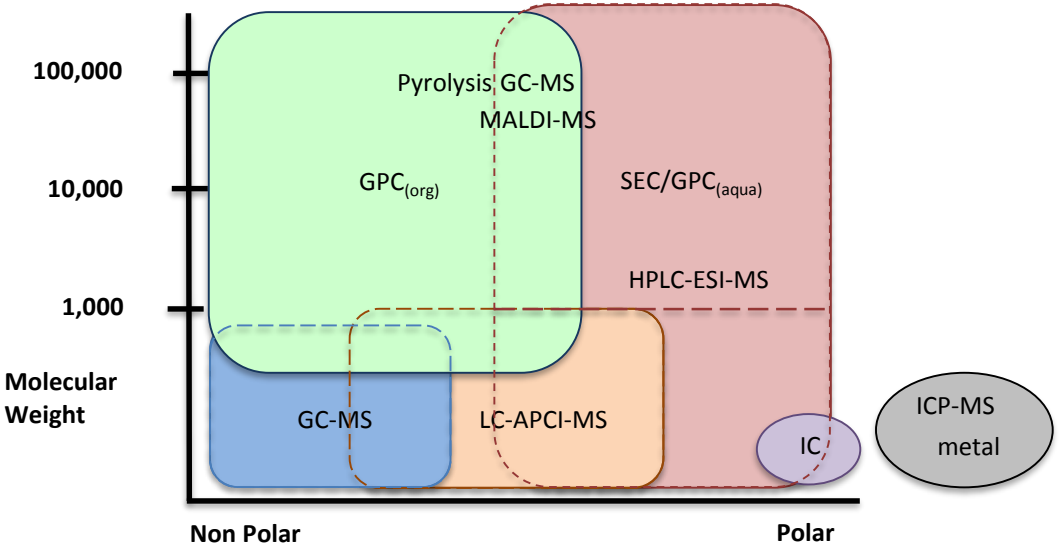
E&I Lab

Metrology Analysis

SEM, AFM, EDX, QCM, *TEM, XRF, XPS, *AES, *SIMS, *XRD, *FIB, contact angle, zeta potential, UltraMicrotome, Cross-section Polisher, Image Analysis

The main Share Lab support for EKC is chemical analysis

- ✓ Formulation component quantification & identification
- ✓ Raw material control

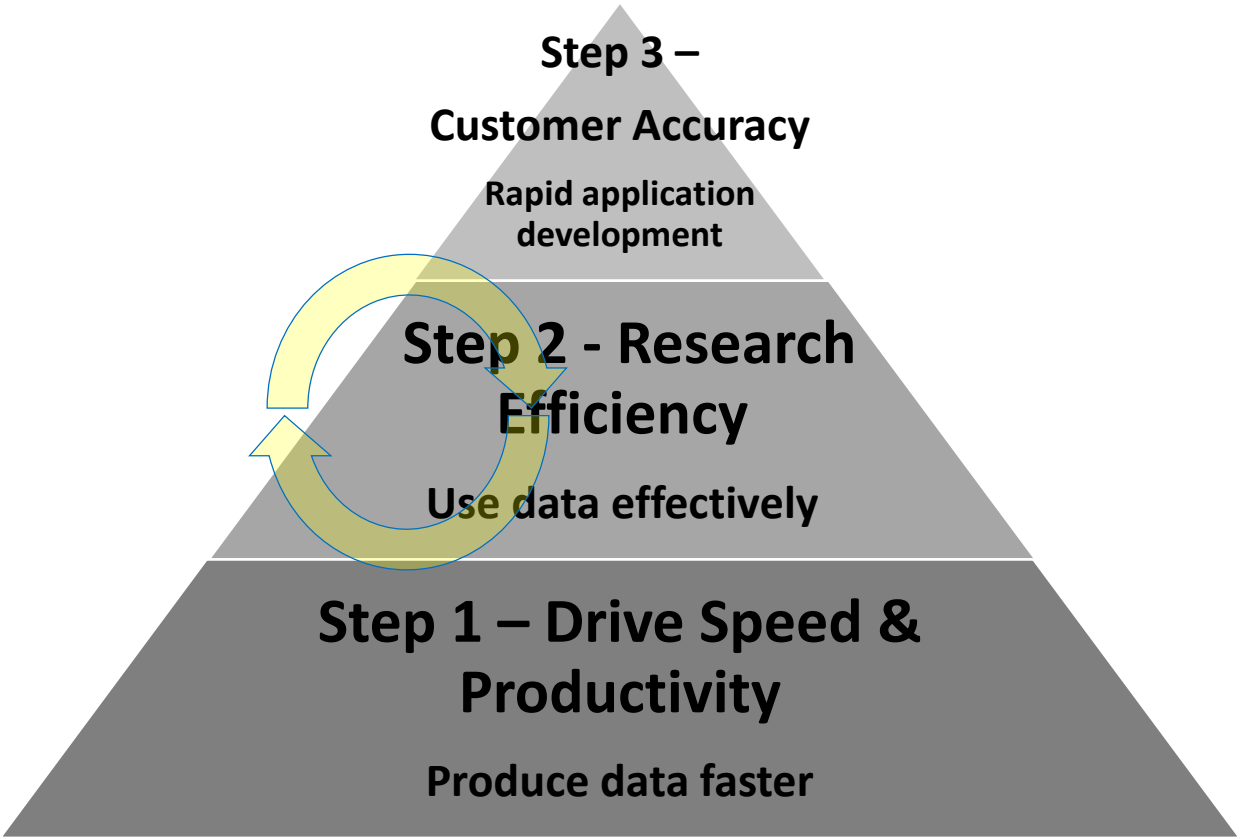


Share Lab support

ICP-MS: Inductively-coupled-plasma Mass Spec.

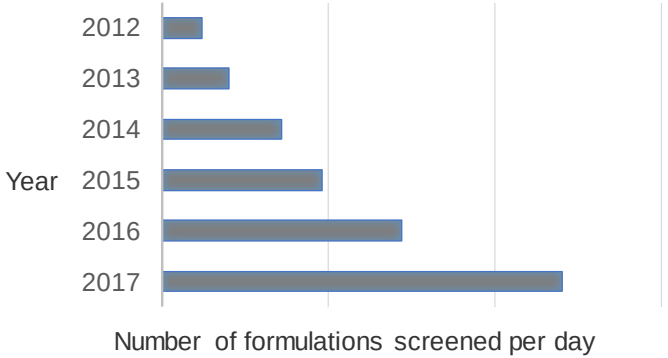
- ✓ GC-MS: Gas chromatography + Mass Spec.
- ✓ HPLC-MS: High-pressure liquid chromatography + Mass Spec.
- ✓ IC: Ion chromatography
- ✓ GPC: Gel-permission chromatography
- ✓ SEC: Size-exclusion chromatography
- ✓ MALDI-MS: Matrix-assisted laser desorption/ionization + Mass Spec.

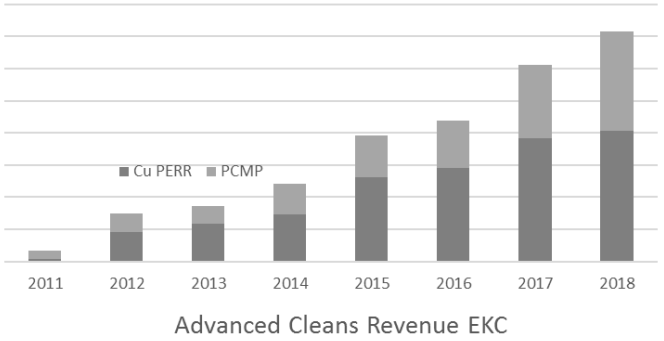
Process Overview – Accelerating Innovation



Step 1 – Drive Speed and Productivity

- Streamline processes and debottleneck steps
- Practice statistical tools on new method development (MSA) to ensure data quality (Gage R&R)
- Automate systems

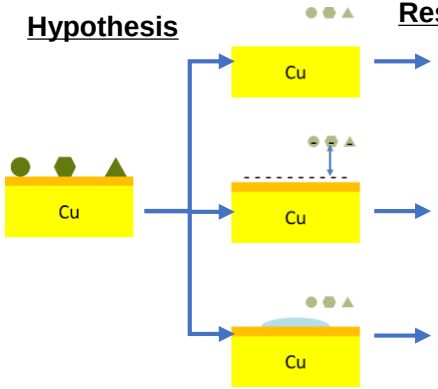




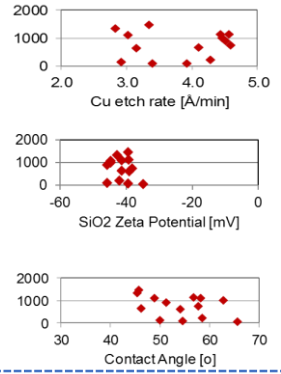
Step 2 – Research Efficiency

- Design of Experiments (DOE)
- Broaden formulation windows and reduce trade off
- Link to fundamental mechanisms

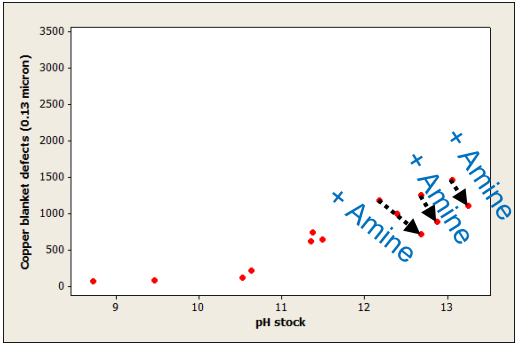
Hypothesis



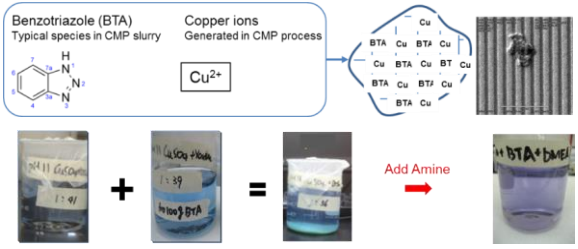
Result: Defect number *vs.* Measure



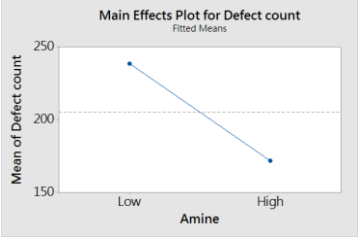
DOE result



New fundamental mechanism proposal



DOE to verify the new mechanism



Step 2 – Research Efficiency

- Continuously improving capability to fulfill customers' needs
  - Method development
    - To improve data quality and speed
    - To link to new fundamental mechanisms
    - To better correlate customers' CTQs

2012: 6 in-house methods	2017: 15 in-house methods
Cu compatibility	Cu compatibility
Co compatibility	Cu2O compatibility
Cu surface contact angle	CuO compatibility
Electrochemistry	CuOx growth behavior observation
SiO2 particle Z.P.	CuBTA dissolution
CuO particle Z.P.	Slurry abrasive redeposition on Copper surface
	AFM adhesion SiO2 particle-to-Copper surface
	Cobalt compatibility
	Galvanic corrosion assessment via pattern structure
	SiO2 particle Z.P.
	CuO particle Z.P.
	Ruthenium compatibility
	RuO2 particle Z.P.
	In-house galvanic corrosion assessment Cu/Ru
	Cu surface contact angle

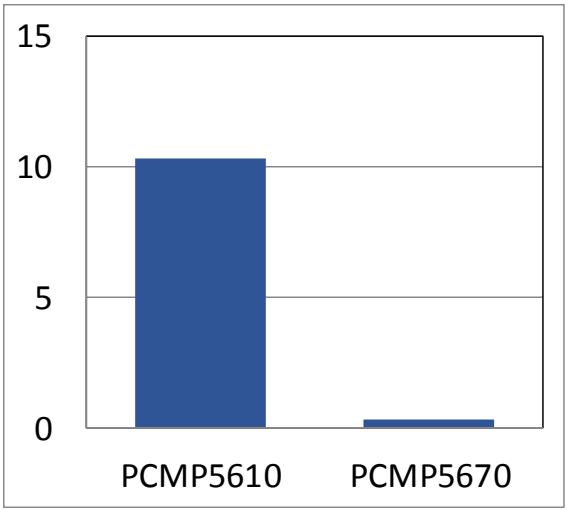
In order to understand potential of a cleaner to meet customers' requirements, the in-house characterization methods increase from 6 up to 15

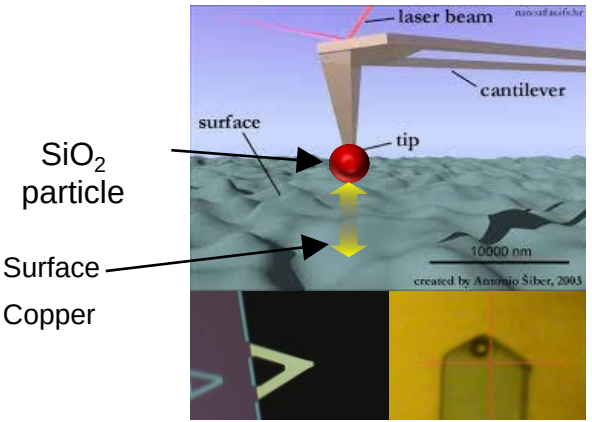
Reduce the adhesion force between “SiO2 particle” and “Copper surface”

Atomic Force Microscopy

Adhesion force [nN]

SiO_2 particle-to-Copper surface



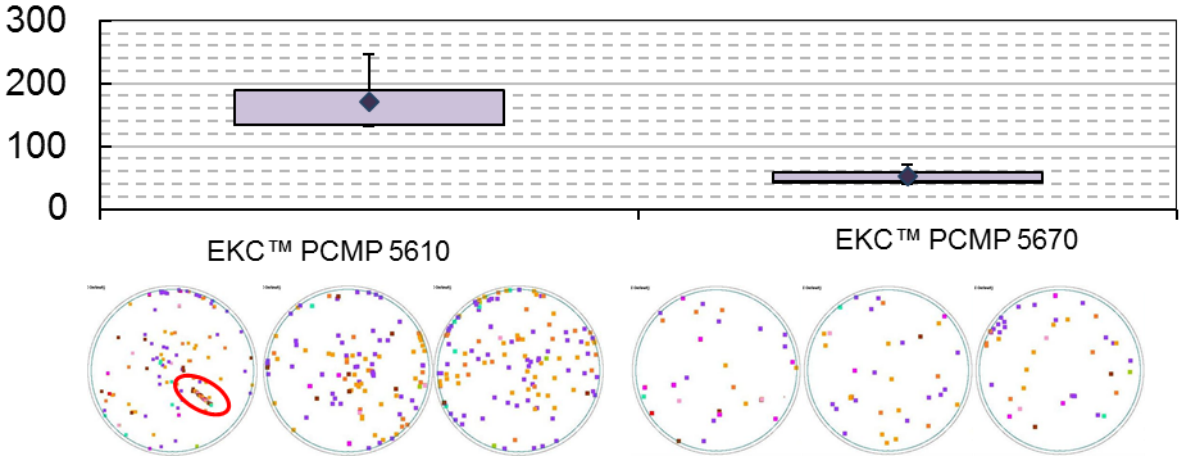


Adhesion force

- Interaction between SiO_2 particle and Copper surface
- The lower adhesion force is , the easier it is to remove particle/organic residue

Full wafer (12”) clean performance demonstration

EKC™PCMP 5670 outperforms EKC™ PCMP5610 in clean performance, i.e. total defect count



Tool Configuration

- Model : Ebara F-REX300 SII
- Cleaning Module : Brush + Pencil + N2/IPA dry

Inspection capability

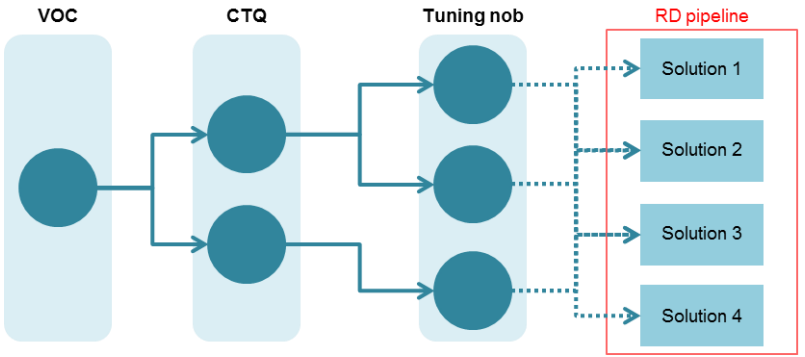
- Model : KLA SP2
- Size : 0.12µm

Consumables

• Slurry	Cu	: DCM-C68 / Fujimi
	Barrier	: HS-BT815-M / Hitachi
• Pad	Cu	: IC1570 / R&H
	Barrier	: H-800 / Fujibo

Step 3 – Customer Accuracy

- Anticipate and plan for a moving target
- Technology is always evolving
  - Merged business enhancing insight into industry trends and roadmap
  - Merged business resources and assets strengthening CIP (continuous improvement products) Pipeline
- Win customers' support
  - Reliance on customers' tools & facilities to verify product performance
  - Act as a solution provider with speed and agility



- Establish CIP (Continuous Improvement Plan) candidates in pipeline
- Accelerate formulation development cycle

Case Study – Customer Troubleshooting

Impact

- ✓ The root-cause of yellowish issue of component comes from an impurity.
- ✓ Develop another way to check the quality of comp Z raw material

Business Background

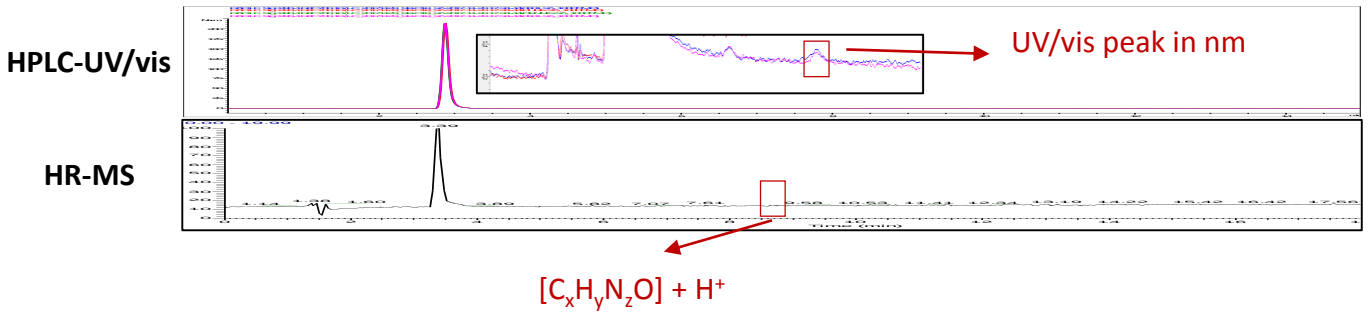
- Some comp Z raw materials in an interconnect cleans product was yellowish in color, which could potentially impact functional performance.

Challenge

- No appropriate method for LC high-resolution-MS (HR-MS) tests.

Solution

- Develop a new chromatography method & new HR-MS techniques



Case Study – Assess Chemical Purity of Raw Materials

Impact

✓ Develop an analysis method to support RD understand potential chemical “impurities”

Business Background

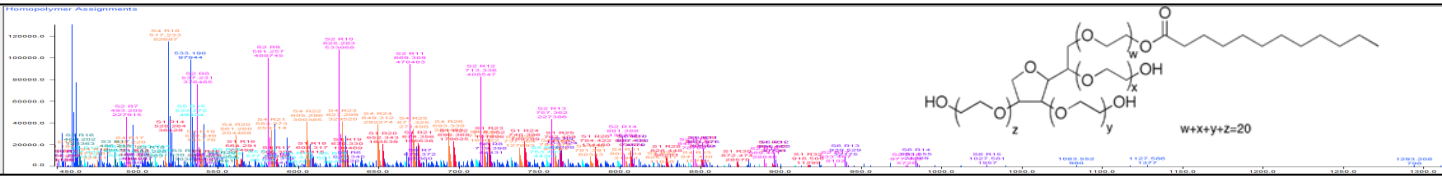
- The chemical structure of a polymer is not always as the vendor claims, which may result in higher organic residue after PCMP.

Challenge

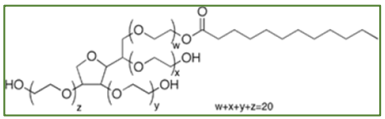
- Mass peaks from LC high-resolution-MS (HR-MS) are too complicated to be analyzed

Solution

- Combined **HR-MS** and **software-assisted mass analysis** **(Consult in CCAS)**



✓ Four kind of PEG polymers are identified in in this suppliers product



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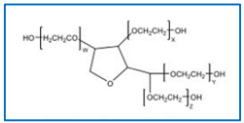

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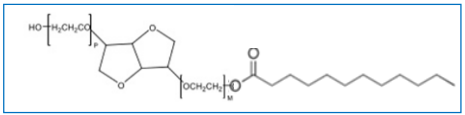

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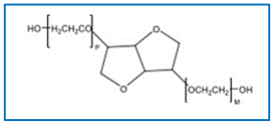

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Case Study – Leveraging DuPont CCAS Support

Contribution

✓ Develop an XPS fitting method for an EKC formulation screening tool, to accelerate an EKC Cu PCMP project

Business Background

- Need a systemic method to quantitate Cu oxidation state after Cu PCMP cleaning.

Challenge

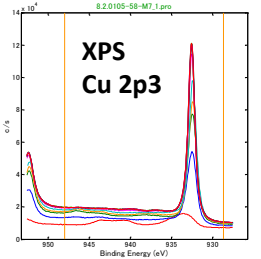
- XPS (X-ray photoelectron spectroscopy) is known as a powerful tool for distinguishing metal oxidation states. However, the Cu $2p_{3/2}$ of Cu(0), Cu(1+) and Cu(2+) are strongly overlapped so that it is difficult to get accurate ratio of 3 oxidation states.

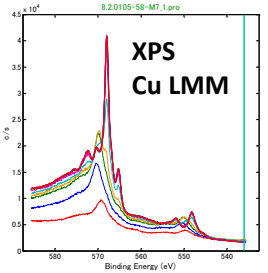
Solution

- Develop a **XPS fitting approach** to calculate the atom % of Cu(0), Cu(1+) and Cu(2+)
- Consulting with a CCAS expert to enhance fitting accuracy through **parameter fine-tune.**

Thickness	C1s, %	N1s, %	O1s, %	Cu2p3 %
0	35.65	7.87	30.61	25.87
2	18.1	5.88	29.87	46.15
10	0	0	27.76	72.24
20	0	0	24.12	75.88
30	0	0	15.97	84.03
40	0	0	4	96
50	0	0	0	100
60	0	0	0	100

relative to SiO_2





XPS Cu Oxidation States Quantitation

Contribution

✓ Develop a XPS fitting method for a EKC formulation screening tool, and provide benefit to Memory projects of EKC Cu PCMP .

Business Background

- RD chemists need a systemic method to quantitate Cu oxidation state after Cu PCMP cleaning.

Challenge

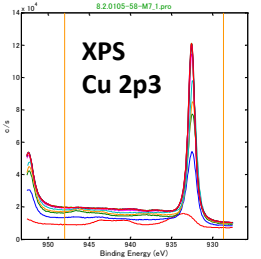
- XPS (X-ray photoelectron spectroscopy) is known as a powerful tool for distinguishing metal oxidation states. However, the Cu $2p_{3/2}$ of Cu(0), Cu(1+) and Cu(2+) are strongly overlapped so that it is difficult to get accurate ratio of 3 oxidation states.

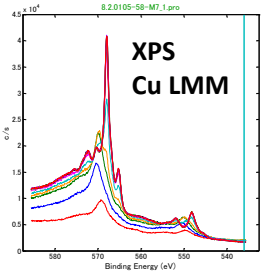
Solution

- Develop a **XPS fitting approach** to calculate the atom % of Cu(0), Cu(1+) and Cu(2+)
- Consulting with a CCAS expert - Lei Chang to enhance fitting accuracy through **parameter fine-tune.**

Thickness	C1s, %	N1s, %	O1s, %	Cu2p3 %	Cu(0), %	Cu(1), %	Cu(2), %
0	35.65	7.87	30.61	25.87	0	5.38	94.62
2	18.1	5.88	29.87	46.15	4.57	72.96	22.47
10	0	0	27.76	72.24	5.82	82.60	11.58
20	0	0	24.12	75.88	21.9	65.55	12.55
30	0	0	15.97	84.03	65.61	23.07	11.32
40	0	0	4	96	92.04	0	7.96
50	0	0	0	100	97.77	0	2.23
60	0	0	0	100	99.41	0	0.59

relative to SiO_2





Summary

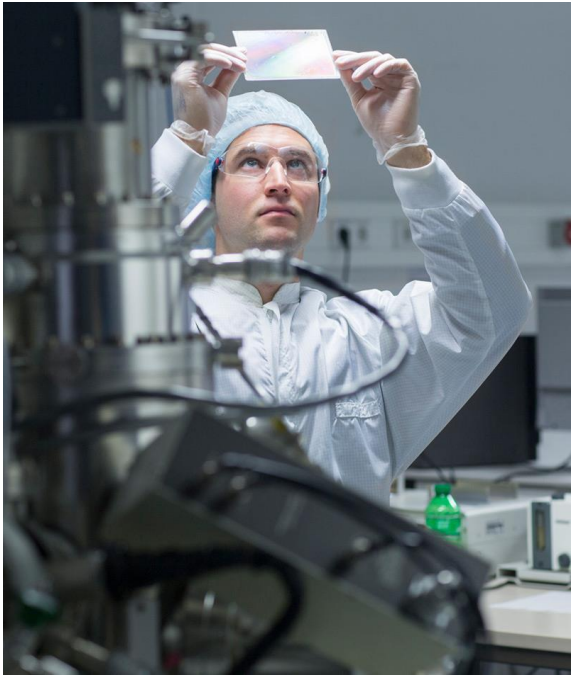
- The merger of Dow and DuPont is creating a stronger more customer focused and committed supplier to the Semiconductor industry.

- Combining and leveraging shared capabilities addresses many key challenges.

- Enables closer collaboration with customers to develop robust solutions.

Our Commitment to Our Customers

- Meeting current needs without disruption; business operations as usual
- Access to greater technological expertise
- Access to an expanded portfolio
- Resources organized effectively for industry dynamics
- Continued focus on manufacturing excellence and reliability
- Commitment to sustainability and core values



“Life is full of surprises, some good, some not so good.”
— Pablo Escobar

Thank You!

This communication contains "forward-looking statements" within the meaning of the federal securities laws, including Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended. In this context, forward-looking statements often address expected future business and financial performance and financial condition, and often contain words such as "expect," "anticipate," "intend," "plan," "believe," "seek," "see," "will," "would," "target," similar expressions, and variations or negatives of these words.

On December 11, 2015, The Dow Chemical Company ("Dow") and E. I. du Pont de Nemours and Company ("DuPont") announced entry into an Agreement and Plan of Merger, as amended on March 31, 2017, (the "Merger Agreement") under which the companies would combine in an all-stock merger of equals transaction (the "Merger Transaction"). Effective August 31, 2017, the Merger Transaction was completed and each of Dow and DuPont became subsidiaries of DowDuPont Inc ("DowDuPont"). For more information, please see each of DowDuPont's, Dow's and DuPont's latest annual, quarterly and current reports on Forms 10-K, 10-Q and 8-K, as the case may be, and the joint proxy statement/prospectus included in the registration statement on Form S-4 filed by DowDuPont with the SEC on March 1, 2016 (File No. 333-209869), as last amended on June 7, 2016, and declared effective by the SEC on June 9, 2016 (the "Registration Statement") in connection with the Merger Transaction.

Forward-looking statements by their nature address matters that are, to different degrees, uncertain, including the intended separation of DowDuPont's agriculture, materials science and specialty products businesses in one or more tax efficient transactions on anticipated terms (the "Intended Business Separations") and the proposed transaction with FMC Corporation, in which, among other things, FMC will acquire a portion of DuPont's Crop Protection business and DuPont will acquire substantially all of FMC's Health and Nutrition business (the "FMC Transaction"). Forward-looking statements are not guarantees of future performance and are based on certain assumptions and expectations of future events which may not be realized. Forward-looking statements also involve risks and uncertainties, many of which are beyond the company's control. Some of the important factors that could cause DowDuPont's, Dow's or DuPont's actual results to differ materially from those projected in any such forward-looking statements include, but are not limited to: (i) successful integration of the respective agriculture, materials science and specialty products businesses of Dow and DuPont, including anticipated tax treatment, unforeseen liabilities, future capital expenditures, revenues, expenses, earnings, synergies, economic performance, indebtedness, financial condition, losses, future prospects, business and management strategies for the management, expansion and growth of the combined operations; (ii) impact of the divestitures required as a condition to consummation of the Merger Transaction as well as other conditional commitments; (iii) the completion of the FMC Transaction on anticipated terms and timing, including the possibility that the FMC Transaction may not close and the anticipated benefits thereof may not be obtained; (iv) achievement of the anticipated synergies by DowDuPont's agriculture, materials science and specialty products businesses; (v) risks associated with the Intended Business Separations, including those that may result from the comprehensive portfolio review undertaken by the DowDuPont board, changes and timing, including a number of conditions which could delay, prevent or otherwise adversely affect the proposed transactions, including possible issues or delays in obtaining required regulatory approvals or clearances related to the Intended Business Separations, disruptions in the financial markets or other potential barriers; (vi) the ability of DowDuPont and DuPont to integrate FMC's Health and Nutrition business and to achieve anticipated synergies; (vii) the risk that disruptions from the Intended Business Separations and the FMC Transaction will harm DowDuPont's business (either directly or as conducted by and through Dow or DuPont), including current plans and operations; (viii) the ability to retain and hire key personnel; (ix) potential adverse reactions or changes to business relationships resulting from the completion of the merger, the Intended Business Separations, and the FMC Transaction; (x) uncertainty as to the long-term value of DowDuPont common stock; (xi) continued availability of capital and financing and rating agency actions; (xii) legislative, regulatory and economic developments; (xiii) potential business uncertainty, including changes to existing business relationships, during the pendency of the Intended Business Separations and the FMC Transaction that could affect the company's financial performance; (xiv) certain restrictions during the pendency of the FMC Transaction that may impact DuPont's ability to pursue certain business opportunities or strategic transactions; and (xv) unpredictability and severity of catastrophic events, including, but not limited to, acts of terrorism or outbreak of war or hostilities, as well as management's response to any of the aforementioned factors. These risks, as well as other risks associated with the merger, the Intended Business Separations, and the FMC Transaction, are or will be more fully discussed in (1) the Registration Statement and (2) in the current, periodic and annual reports filed with the SEC by DowDuPont and to the extent incorporated by reference into the Registration Statement, by Dow and DuPont, and/or (3) DuPont's and Dow's most recently filed Form 10-K, 10-Q and 8-K reports. While the list of factors presented here is, and the list of factors presented in the Registration Statement are, considered representative, no such list should be considered to be a complete statement of all potential risks and uncertainties. Unlisted factors may present significant additional obstacles to the realization of forward-looking statements. Consequences of material differences in results as compared with those anticipated in the forward-looking statements could include, among other things, business disruption, operational problems, financial loss, legal liability to third parties and similar risks, any of which could have a material adverse effect on DowDuPont's, Dow's or DuPont's consolidated financial condition, results of operations, credit rating or liquidity. None of DowDuPont, Dow or DuPont assumes any obligation to publicly provide revisions or updates to any forward-looking statements regarding the proposed transaction and intended business separations, whether as a result of new information, future developments or otherwise, should circumstances change, except as otherwise required by securities and other applicable laws.