



Value Creation Through Open Innovation at PPG

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Moderator:
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University of Pittsburgh



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PPG Industries

Value Creation Through Open Innovation at PPG

UIDP Presentation - 2021

Sharon Feng, Ph.D.
Director, Corporate Science & Technology



Two product segments
drive our \$15.1B business*

Performance Coatings: 59%

Industrial Coatings: 41%



Aerospace



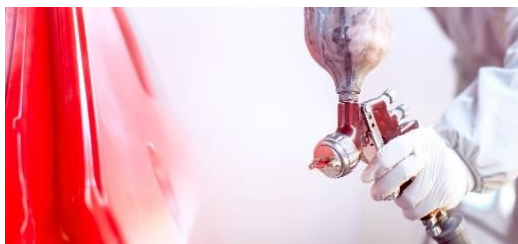
Architectural Coatings**



Automotive OEM Coatings



Industrial Coatings



Automotive Refinish Coatings



Protective and Marine Coatings



Packaging Coatings



Specialty Coatings and Materials

PPG *is*



LEADER
IN THE
INDUSTRIAL
TRANSPORTATION
CONSUMER PRODUCTS CONSTRUCTION MARKETS
& AFTERMARKETS



ENHANCES
MORE SURFACES IN MORE WAYS
THAN ANY OTHER
COMPANY

GLOBAL MAKER of
PAINTS
COATINGS
OPTICAL PRODUCTS
SPECIALTY MATERIALS
GLASS & FIBERGLASS



OWNED BY
215,000
SHAREHOLDERS
INCLUDING
14,000 EMPLOYEES and RETIRES

46,000+
EMPLOYEES



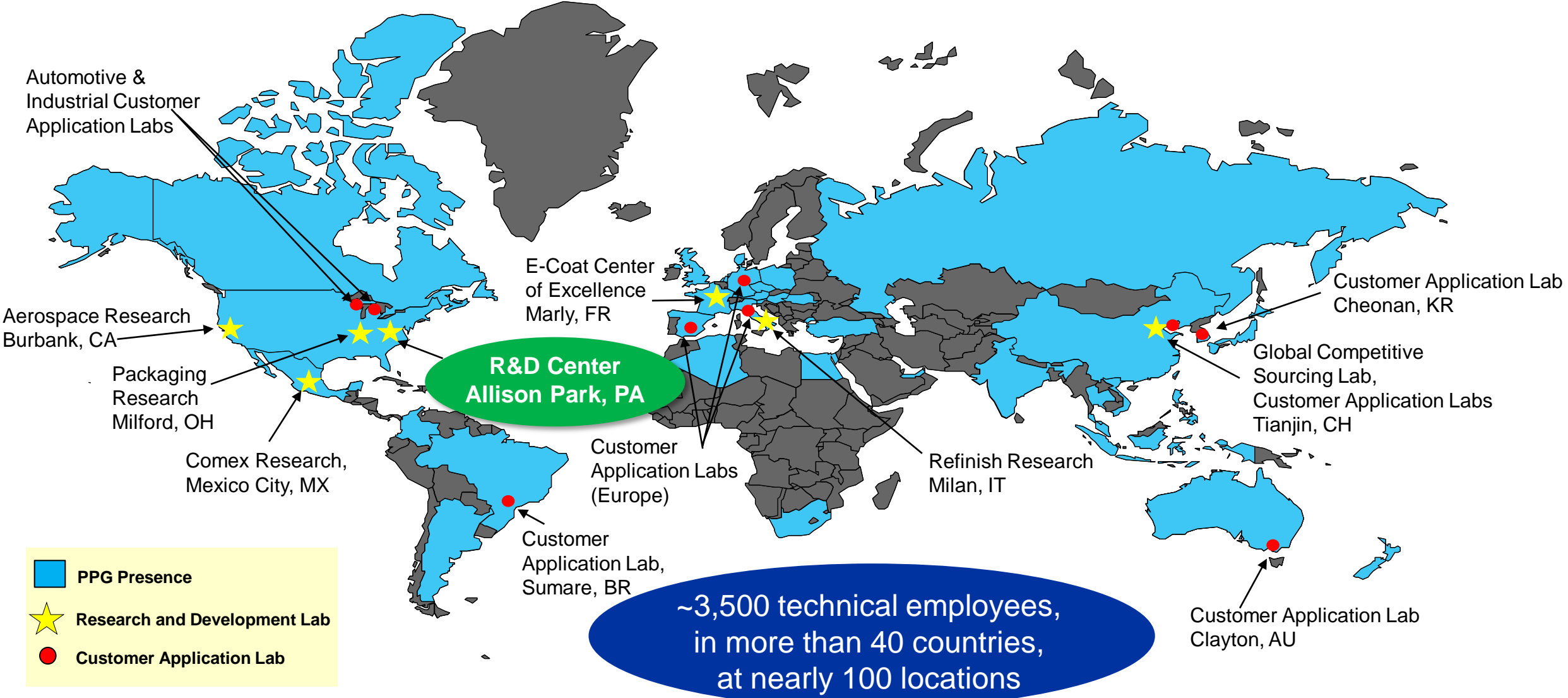
OPERATIONS IN NEARLY **70** COUNTRIES



\$456MM 2019 R&D Expenditures



PPG's Global Technical Footprint

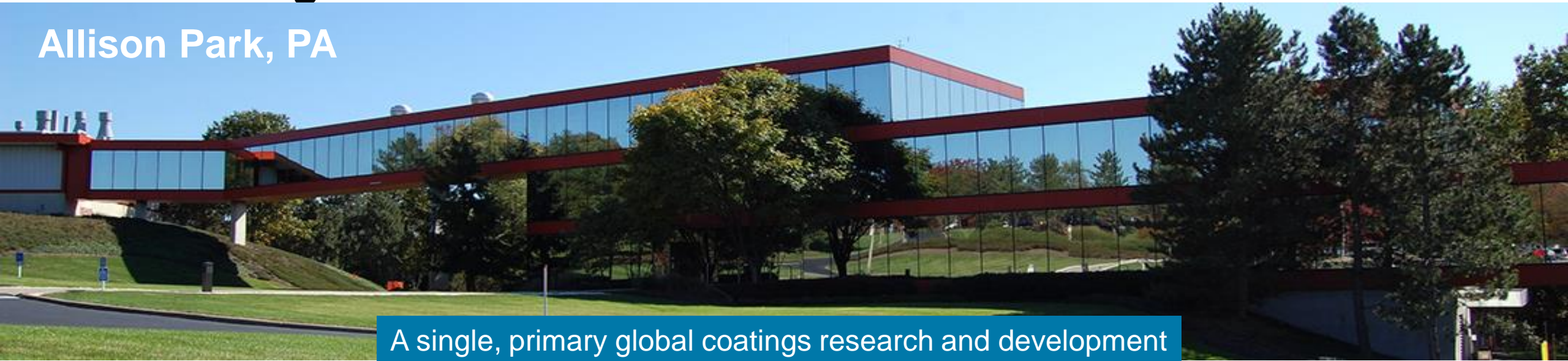


Global research & development efforts to service customers locally



PPG Coatings Innovation Center

Allison Park, PA



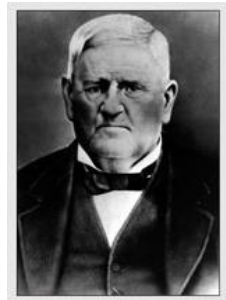
A single, primary global coatings research and development facility ensures technology spread across company

Core Activities

- Resin Synthesis
- Formulation
- Application
- Analytical Capability
- Physical and Computational Chemistry
- High Throughput Methodologies
- Process Engineering
- Development Center (Pilot Plant)

~300 researchers:
synthesis chemists, formulators,
analytical chemists, engineers

PPG History of Organic Innovation



1883 - **Pittsburgh Plate Glass**
(PPG) Founded by Ford & Pitcairn

1900 - Acquires **Patton Paint Co.** and **Columbia Chemical Co.**



1910 - Opens the company's **first R&D facility**



1938 - Patents **CR-39®** monomer pioneering plastics ophthalmic lenses



1940 - Develops **laminated aircraft glass**



1967 - Introduces **Duranar®** fluoropolymer coatings to China



1963 - Revolutionizes auto industry with **electrodeposition coating process**



1968 - Reflecting diversification - becomes **PPG Industries**



1975 - Introduces **DesignaColor** consumer paints



1987 - Develops **Teslin®** synthetic printing material



1990 - Develops **Transitions®** lenses that darken in sunlight



1998 - Introduces **G1** coatings for easy opening can ends



2000 - Silicas add to performance of athletic footwear. **Enviroprime®** global lead free Ecoat launched



2002 - Produces fiber glass for wind. Introduces lead free **FrameCoat®** and **Ceramiclear®** mar-resistant coating



2004 - Introduces **B1:B2** compact paint process



2008 - Introduces **Zircobond®** pretreatment



2009 - Introduces **Duranar®** Powder



2014 - BPA-NI needs met with **Innoval HPS®**



2015 - **Metal Free E-coat**



2018 - Introduces **Delfleet One®**, new CT platform



2017 - Introduces **PPG Timeless**

R&D 100

PPG history of growth through innovation



University Partnership – Essential To PPG Innovation Eco System

Why - For PPG

- Access diverse talent pool
- Access capabilities (supercomputers, unique infrastructures such as BSL labs and cleanrooms)
- Access cutting edge researches by engaging faculty/students
- Branding



Why - For University Partners

- Access future employees for students
- Access outlet to translate fundamental research into impactful technologies
- Market access/channels for validation of value proposition
- Access industrial research infrastructure – people/equipment for prototype testing and validation
- Access opportunity to provide real world research experience for students (interns, collaboration project) to enhance readiness for entering workforce
- Partner to seek government funding – increasingly desired by funding agencies

University Partnership – Essential To PPG Innovation Eco System

How to Engage:

- Strategic universities
- Partners on government grants
- Partner programs
- Individual research collaborations
- People exchange

PPG Foundation Support

- Unrestricted gifts.

What:

Information Exchange

- PPG Tuesday Seminars

PPG-funded research programs

- 10+ funded research projects per year at strategic universities.
- Cutting edge research: nanomaterials, 3D printing, machine learning, polymer science, among others.
- PPG funds work directly at universities or via government agencies.

Talent Recruitment

- Recruiting talent in Chemistry, Polymer Science, Engineering and Data Science.

PPG Foundation Support

- Joint program for DE&I focused talent pipeline development

Strategic University Partnership Examples



National Lab Partners



National Lab Research

- Materials for Energy Storage
- Cool Roof/IR Reflective Materials
- Supercomputer Modeling Performance and Degradation of Coatings and Adhesives
- Supercomputer Modeling Anti-corrosion Molecule Performance
- Supercomputer Modeling Spray Application Atomization
- Supercomputer Modeling Film Formation of Coatings

Government Funded Research



U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

Examples of Funded Projects:

Additive Manufacturing
Environmentally-friendly Coatings
Corrosion and Chemical Agent Resistant Coatings
High-performance Adhesives
Energy Storage Materials
Coatings for Autonomous Vehicle Coatings
Water Filtration
Energy Efficient Manufacturing Materials and Technology

Examples of Additional University Partners:

North Dakota State University
Drexel Univ.
Rowan Univ.
Oakland Univ. (MI)
Michigan State University
University of Maine (new)
City College of New York
Virginia Tech.
The Ohio State University



High Performance Adhesives

Technology Gap

- Department of Defense funded
- Develop an explosion resistant adhesives for military vehicles

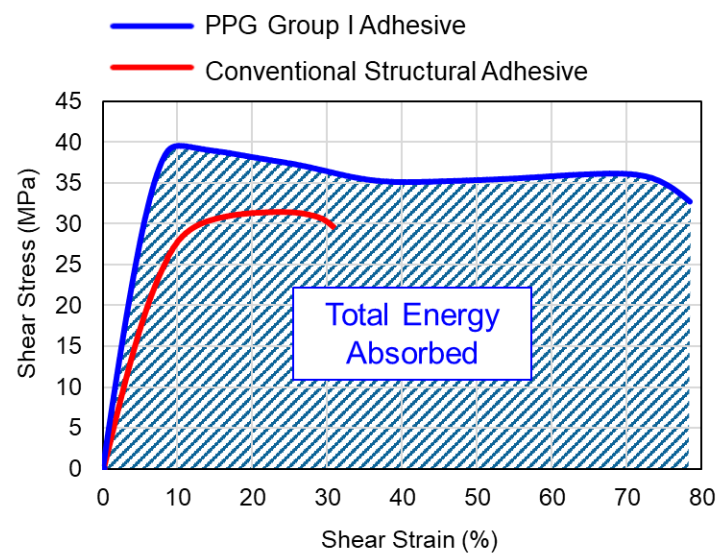


- Partnership with the Army Research Lab



PPG Solution

- New additive enables a tunable technology
- Superior performance
 - Adjustable formulation meets specifications across markets



Successes

Projected market growth across segments



Military Applications
\$10MM currently



Automotive
\$1.7B by 2023



Aerospace
\$1.1B by 2023

Developed a tunable adhesive that meets needs across coating markets



Image Processing & Analysis: Coating Defects

Technology Gap

Image Analysis

- Field/lab images are not traditionally used beyond retention/compliance purposes



- Partnership with universities to develop computer vision / machine learning techniques

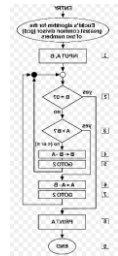
PPG Solution

Image analysis process:

Image captured

Interpretation
of input data

Algorithms applied



Output

Informed recommendation
leads to **human decision**

Successes

Minimal Viable Product:

- Predictive analytics to assess performance/quality of coatings



Development of new
Machine Learning methods
and projects based on
images and formulation

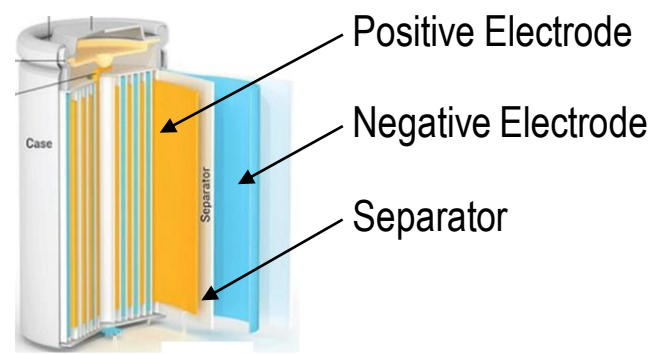


Battery Coating Cathode Binder

Technology Gap

Batteries: coated metal sheets

- ~4x increase in coating content per vehicle



Coatings can:

- Lower manufacturing cost
- Improve performance
- Extend battery life
- VOC compliance

PPG Solution

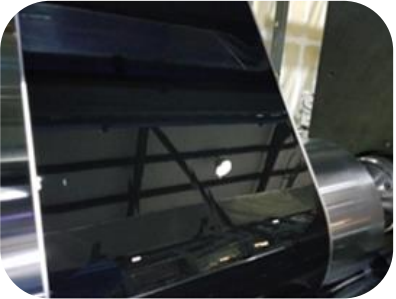
PPG binder delivers:

- Flexibility and adhesion
- Ease of application
- Improved processing
- Defect control



Coating Slurry

Coated Cathode



Successes

Qualification progresses with several key players:

- Several battery manufacturers
- Automotive OEMs

Strong IP portfolio

(12) United States Patent Helling et al.		(10) Patent No.: US 10,033,043 B2
		(45) Date of Patent: *Jul. 24, 2018
(54) ELECTRODE BINDER COMPOSITION FOR LITHIUM ION ELECTRICAL STORAGE DEVICES	(56) References Cited U.S. PATENT DOCUMENTS	
(71) Applicant: PPG Industries Ohio, Inc., Cleveland, OH (US)	3,716,599 A 4,039,497 A 1,309,328 A 1,314,004 A 1,379,885 A 5,349,003 A 5,464,897 A 5,776,637 A 6,037,080 A 6,083,644 A 6,159,635 A 6,228,533 B1 6,231,626 B1 6,294,290 B1 6,531,541 B1 6,656,633 B2 6,756,153 B1 6,770,397 B1 6,881,517 B1 7,282,528 B2 7,316,864 B2 7,351,498 B2 7,625,973 B2 7,659,335 B2	2/1973 Vasta et al. 8/1977 Troussier et al. 1/1982 Carson et al. 2/1982 Stoneberg 4/1983 Miller et al. 9/1994 Kato et al. 11/1995 Das et al. 7/1998 Kashio et al. 3/2000 Kronfil et al. 7/2000 Watanabe et al. 12/2000 Dasgupta et al. 5/2001 Ohashi et al. 5/2001 Yoshida et al. 9/2001 Kim 3/2003 Desai et al. 12/2003 Yamakawa et al. 6/2004 Yamamoto et al. 8/2004 Maeda et al. 4/2005 Kanazaki et al. 10/2007 Asano et al. 1/2008 Nakayama et al. 4/2008 Watarai et al. 12/2009 Ambrose et al. 2/2010 Koube 7/2010 Ohara et al.
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 5 days. This patent is subject to a terminal disclaimer.		
(21) Appl. No.: 15/196,185		



University Partnership – Essential To PPG Innovation Eco System

- Aligned vision, mission and priorities
- Win Win relationship
- Workable IP terms
- Streamlined processes including effective coordinator(s) to help navigate university administrative maze
- Faculty who understand and are adaptable to industrial research model (customer minded, speed and communication cadence)
- History of successful collaborations





We protect and beautify the world™



Partnering and Collaborating with GSK

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Paul Van Dun
KU Leuven R&D



John Wilson
GSK

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Strengthening
University-Industry
Partnerships