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Polymeric Coatings

Chicago, IL | Aug 20 - Aug 21, 2022

Explore recent technological advances in coatings science to help solve coatings challenges while considering existing environmental regulations.

In this course, you will learn the following:

• How to design, synthesize, formulate, and evaluate polymeric coatings
• How to capitalize on fundamental knowledge to create innovative polymeric coatings
• The role of polymeric coatings on the future of functional materials
• Examples of environmentally compliant and sustainable polymeric coatings.

Register Today at www.acs.org/PolymericCoatings

Facilitated By: Marek W. Urban, Professor, Clemson University
Polymeric Coatings: From Fundamentals to Future Technologies

Marek W. Urban

Department of Materials Science and Engineering
Clemson University

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WHAT ARE POLYMERIC COATINGS?

MACROMOLECULES OR POLYMERS…OR PLASTICS…

COMPLEX MATERIALS, APPLICATION-DRIVEN COMPOSITES

COMPOSED OF MACROMOLECULES AND OTHER COMPONENTS

SERVING IN MANY ENVIRONMENTS
SERVING MANY APPLICATIONS

TRADITIONAL AUTOMOTIVE COATINGS

A MULTI-LAYERED COMPOSITE COATING

CLEAR - GLOSS
BASE - COLOR
PRIMER
E-COAT
METAL

WHAT IF POLYMERIC COMPOSITES ARE USED AS SUBSTRATES?
TRADITIONAL POLYMERIC COATINGS

- PROTECT SUBSTRATES; ENVIRONMENTALLY COMPLIANT
- ADHERE TO SUBSTRATES

anticipated 2021-23 growth of acrylic coatings is about ~5%

TO UNDERSTAND POLYMERIC COATINGS’ DESIGN
IT IS CRITICAL TO KNOW FUNDAMENTALS

THE ACS SHORT COURSE ADDRESSES THESE QUESTIONS

- Chap.1 Introduction; Coatings Science
- Chap.2 Addition Polymerization
- Chap.3 Step Growth Polymerization
- Chap.4 Ring-Opening Polymerization
- Chap.5 Emulsion Polymerization
- Chap.6 Emulsion Polymerization Strategies
- Chap.7 Crosslinking Agents in Thermosets
- Chap.8 Powder Coatings
- Chap.9 Conversion of Organic to Water-Borne; Water Dispersible Polymers
- Chap.10 Radiation Curing
- Chap.11 Pigments and PVC
- Chap.12 Extender Pigments and Nano-Particles

HOW ALL COATINGS COMPONENTS INTERACT WITH EACH OTHER?
TRADITIONAL POLYMERIC COATINGS SERVE TWO MAIN FUNCTIONS: PROTECT and BEAUTIFY **IS THIS ENOUGH?**

**TRADITIONAL COMPONENTS:**
- POLYMER OR “PLASTIC” PART (BINDER)
- PIGMENT OR COLORING COMPONENTS
- SOLVENTS (?)
- ADDITIVES

IN ADDITION TO:
- PROTECT and BE ENVIRONMENTALLY ACCEPTABLE
- ADHERE TO SUBSTRATES

**MODERN POLYMERIC COATINGS SHOULD BE:**
- INEXPENSIVE, EASY TO PRODUCE
- INTELLIGENT (RESPONSIVE, ADAPTIVE)
What is the anticipated growth of Acrylic-based Polymeric Coatings during the 2018-2023 Period?

• About 1 percent
• About 4 percent
• About 5 percent
• About 8 percent

* If your answer differs greatly from the choices above tell us in the chat!

COATINGS SCIENCE

MOLECULAR DESIGN

Solvent-Borne Systems
Water-Borne Systems
Latexes
High Solids
Powder Coatings
Radiation Curing

- Molecular Level Adhesion
- Molecular Interactions
- Stratification/Crosslinking/Degradation
- Surface/Interfacial Properties

ANALYSIS OF COATINGS

- Molecular and Macro Levels
  - Spectroscopic Approaches
  - Thermomechanical Approaches
  - Macroscopic Testing

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Molecular Design

Polymer Backbone

- Hydrophobic Side Chain
- Primary Amines
- Bound Bile Acid
- Quaternary Amine Side Chains

PHYSICO-CHEMICAL STIMULI THAT MAY BE INCORPORATED INTO POLYMERIC COATINGS

Stimulus-Responsive Macromolecules in Polymeric Coatings; https://doi.org/10.1080/15583724.2022.2065299
Which of these companies are considered key players in Urethane production?

- 1) Dow Inc., BASF SE, Covestro AG, and Huntsman International LLC
- 2) Eastman Chemical Company, Mitsui & Co. Plastics Ltd, and Mitsubishi Chemical Corporation
- 3) Recticel NV/SA, Woodbridge, DIC Corporation, and RTP Company
- 4) The Lubrizol Corporation, RAMPF Holding GmbH & Co. KG, and Tosoh Corporation
- 5) All of the above

* If your answer differs greatly from the choices above tell us in the chat!
Future Directions

SELF-HEALABLE POLYMERIC COATINGS


Composition Dependent Self-repair of p(MMA/nBA) Copolymers

- Self-healing occurs with a narrow compositional range (45/55-50/50 MMA/nBA)
- Higher nBA concentrations cause copolymer flow

Future Directions

Covalently Adaptable Networks (CANs)

Reprocessable Thermosets
Associative/Dissociative Dynamic Covalent Bonds

Chem. Eng. J. 385, 2020, 123820

Combining Self-Healing and CANs

Macromolecules, 2022, in press.
How much is the global self-healing coatings market expected to grow during the period during the next 7 years (2022-2029)?

- About 5 percent
- About 10 percent
- About 15 percent
- About 20 percent
- About 25 percent

* If your answer differs greatly from the choices above tell us in the chat!
WHAT WILL WE LEARN?

• How to capitalize on fundamental knowledge to create innovative polymeric coatings

• What is the role polymeric coatings on the future of functional materials

• Environmentally compliant, sustainable, and reprocessable polymeric coatings

• What are directions of future coatings technologies:
  • Nanotechnologies
  • “Smart” Coatings
  • Making Commodity Coatings ‘Smart’
Polymeric Coatings

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How Polymeric Materials Protect Our Armed Forces

Co-produced with ACS Division of Polymer Chemistry

Thurs., June 16, 2022 | 2:00pm–3:15pm ET

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Co-produced with ACS Division of Small Chemical Businesses and ACS Division of Business Development & Management

Facilitated By: Marek W. Urban, Professor, Clemson University
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