



www.acs.org/acswebinars



Questions or Comments?

Type them into the questions box!



"Why am I muted?"

Don't worry. Everyone is muted except the Presenter and the Host. Thank you and enjoy the show.



1

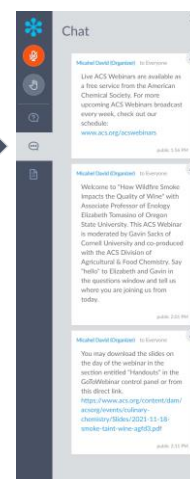
1



www.acs.org/acswebinars



Chat
Announcements and hyperlinks from our team



2

2

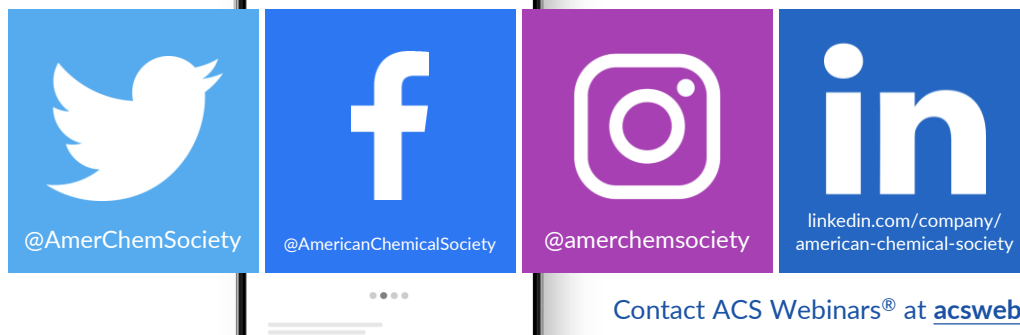


www.acs.org/acswebinars



Let's Get Social!

Follow the American Chemical Society on Twitter, Facebook, Instagram, and LinkedIn for the latest news, events, and connect with your colleagues across the Society.



Contact ACS Webinars® at acswebinars@acs.org

3



www.acs.org/acswebinars



Where is the Webinar Recording?



All Registrants

Watch the unedited recording linked in the **Thank You Email** for 24 hours.



ACS Members w/Premium Package

Visit the [ACS Webinars® Library](#) to watch the **edited and captioned** recording.

4

4



A science podcast by the American Chemical Society about things small in size but BIG in impact.



Sam Jones, PhD
Science Writer & Exec Producer



Deboki Chakravarti, PhD
Science Writer & Co-Host

TO SUBSCRIBE

visit <http://www.acs.org/tinymatters> or scan this QR code



5

ACS Industry Member Programs

- **ACS Industry Matters**

ACS member only content with exclusive insights from industry leaders to help you succeed in your career. #ACSIndustryMatters

Preview Content: [acs.org/indnl](https://www.acs.org/indnl)

- **ACS Innovation Hub LinkedIn Group**

Connect, collaborate and stay informed about the trends leading chemical innovation.

Join: bit.ly/ACSinnovationhub

6

A Career Planning Tool For Chemical Scientists



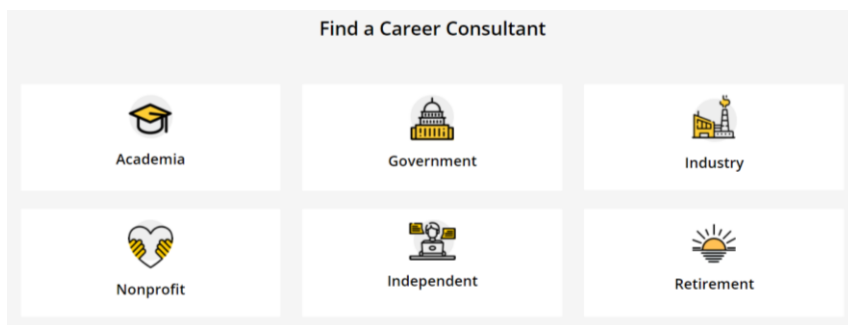
ChemIDP is an Individual Development Plan designed specifically for graduate students and postdoctoral scholars in the chemical sciences. Through immersive, self-paced activities, users explore potential careers, determine specific skills needed for success, and develop plans to achieve professional goals. **ChemIDP** tracks user progress and input, providing tips and strategies to complete goals and guide career exploration.

<https://chemidp.acs.org>

7

7

Career Consultant Directory

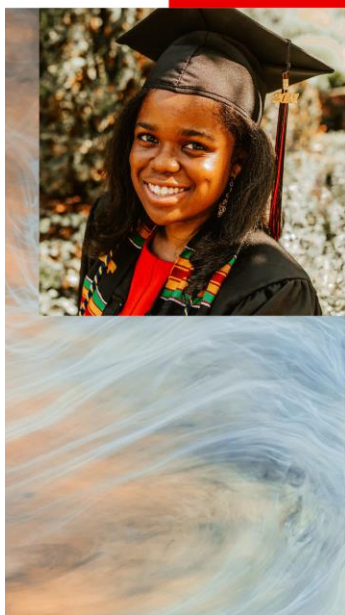


- ACS Member-exclusive program that allows you to arrange a one-on-one appointment with a certified ACS Career Consultant.
- Consultants provide personalized career advice to ACS Members.
- Browse our Career Consultant roster and request your one-on-one appointment today!

www.acs.org/careerconsulting

8

8



ACS Scholar Adunoluwa Obisesan

BS, Massachusetts Institute of Technology, June 2021
(Chemical-biological Engineering, Computer Science & Molecular Biology)

“The ACS Scholars Program provided me with monetary support as well as a valuable network of peers and mentors who have transformed my life and will help me in my future endeavors. The program enabled me to achieve more than I could have ever dreamed! Thank you so much!”

GIVE TO THE
ACS SCHOLARS PROGRAM

Donate today at www.donate.acs.org/scholars

9

Atlantic Basin Conference on Chemistry

Linking the World Through Chemistry

13-16 DECEMBER 2022 | MARRAKECH, MOROCCO

Visit ABCChem.org for more information

 **ABCChem**
ATLANTIC BASIN CONFERENCE ON CHEMISTRY

#ABCChem2022

10

ACS Career Resources



Professional Development & Education

<p>ACS Professional Education Starting and ending experiences from being exposed to new job careers and where your career.</p>	<p>ACS Leadership Development A suite of flexible, free and online courses for getting your leadership skills to leading greatness.</p>	<p>ACS Institute An online learning platform offers a virtual collection of learning and training resources taught by leading experts.</p>
<p>Virtual Classrooms Brought to you by ACS Career Pathways™, these online classrooms can provide exposure to key you, expand your career goals.</p>	<p>ACS Webinars Hundreds of webinars presented by subject matter experts in the chemical enterprise.</p>	<p>Career Events Free webinars and networking opportunities for the career chemistry professionals.</p>
<p>ACS on Campus These events where students can interact with top professionals, learn and networking from ACS advisors and get career tips.</p>	<p>Podcast to Faculty Workshop An annual networking for professional faculty members to meet by podcast in the chemical enterprise.</p>	<p>Career Kick-Starters Workshop A one-day career development workshop for graduate students and postdoctoral scholars.</p>

Managing Your Career

<p>ACS Career Pathways™ Helping leading chemical professionals and graduate students in industry, higher education, government and working for yourself.</p>	<p>Career Consultants Professional consulting services to address your meaningful career decisions and first steps in your job search.</p>	<p>ChemISP™ ACS Institute developed free services for graduate students and postdoctoral scholars.</p>	<p>Résumé Review Get to know your résumé & we will do a 10-minute review to support your job search.</p>
---	---	---	---

<https://www.acs.org/content/acs/en/careers/developing-growing-in-your-career.html>

Register for a 2022 Virtual Office Hour

7 APR	How to Write a Resume ○ April 7, 2022	5 MAY	Careers in Government ○ May 5, 2022
2 JUN	Entrepreneurship ○ June 2, 2022	7 JUL	Networking ○ July 7, 2022
4 AUG	Is Grad School Right for Me? ○ August 4, 2022	1 SEP	Leadership and Soft Skills Development - What You Need to Advance in Your Career ○ September 1, 2022

<https://www.acs.org/content/acs/en/careers/personal-career-consulting.html>

11

11

Get in touch with the Office of Diversity, Equity, Inclusion & Respect

The Office of Diversity, Equity, Inclusion & Respect (DEIR) is the central hub at the American Chemical Society that coordinates, supports, and guides all efforts by staff, members, and governance toward Strategic Goal 5, “Embrace and Advance Inclusion in Chemistry.” The Office of DEIR at ACS is committed to empowering everyone, irrespective of lived experience and intersectionality of identities, to fully participate in the chemistry enterprise. The Office of DEIR welcomes comments, suggestions, and questions around issues of diversity, equity, inclusion, and respect from members at any time. Please do not hesitate to reach out to the Office through this form.

Please do not hesitate to reach out to the Office of DEIR at diversity@acs.org

<https://fs7.formsite.com/acsdiversity/ACSMemberFeedback/index.html>



12

12

ACS Bridge Program

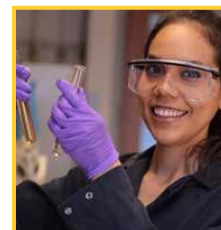


Are you thinking of Grad School?

If you are a student from a group underrepresented in the chemical sciences, we want to empower you to get your graduate degree!

The ACS Bridge Program offers:

- A FREE common application that will highlight your achievements to participating Bridge Departments
- Resources to help write competitive grad school applications and connect you with mentors, students, and industry partners!



Learn more and apply at www.acs.org/bridge

Email us at bridge@acs.org

13

13

Polymeric Coatings



American Chemical Society

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

14



www.acs.org/acswebinars



NEXT WEEK!

Thurs., June 9, 2022 | 2:00pm–3:15pm ET

How to Plan and Organize Your Competitive Research Proposal

Co-produced with Student & Postdoctoral Scholars Office and the Petroleum Research Fund



Wed., June 15, 2022 | 2:00pm–3:30pm ET

How Polymeric Materials Protect Our Armed Forces

Co-produced with ACS Division of Polymer Chemistry



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

Starting a Company: How to Setup Equity and Securities Structures

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

Register for Free

Browse the Upcoming Schedule at www.acs.org/acswebinars

15

15



www.acs.org/acswebinars



**THIS ACS WEBINAR®
WILL BEGIN SHORTLY...**

👋 Say hello in the questions window!

16

16



www.acs.org/acswebinars



Download
the Presentation Slides
Under Handouts



ACS Webinars[®]
CLICK • WATCH • LEARN • DISCUSS

Polymeric Coatings: From Fundamentals to Future Technologies



MAREK W. URBAN, PhD

Professor of Materials Science and
Engineering, Clemson University



BRYAN TWEEDY, BS

Assistant Director, ACS Education,
Office of Career and Professional
Education, American Chemical Society

This ACS Webinar[®] is co-produced with the ACS Office of Career and Professional Education.

17

17

Polymeric Coatings: From Fundamentals to Future Technologies

Marek W. Urban



CLEMSON

mareku@clemson.edu

www.cecas.clemson.edu/urbanresearch

Copyright 2002-2022 © Marek W. Urban

18

18

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



Copyright 2002-2022 © Marek W. Urban

19

19

TRADITIONAL AUTOMOTIVE COATINGS

A MULTI-LAYERED COMPOSITE COATING

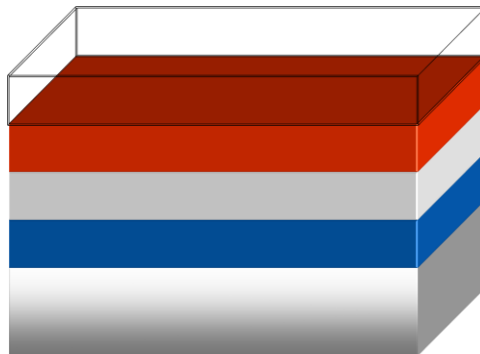
CLEAR - GLOSS

BASE - COLOR

PRIMER

E-COAT

METAL



WHAT IF POLYMERIC COMPOSITES ARE USED AS SUBSTRATES?

Copyright 2002-2022 © Marek W. Urban

20

20

COATED ITEMS ARE USUALLY NOT NOTICED UNLESS THERE IS A PROBLEM FOR THE MOST PART ARE NOT APPRECIATED



TRADITIONAL POLYMERIC COATINGS

- PROTECT SUBSTRATES; ENVIRONMENTALLY COMPLIANT
- ADHERE TO SUBSTRATES

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

Copyright 2002-2022 © Marek W. Urban

21

21

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?

Copyright 2002-2022 © Marek W. Urban

22

22

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



Copyright 2002-2022 © Marek W. Urban

23

23

IN ADDITION TO:

- PROTECT and BE ENVIRONMENTALLY ACCEPTABLE
- ADHERE TO SUBSTRATES



MODERN POLYMERIC COATINGS SHOULD BE:

- 3I**
- INTEGRATED INTO DEVICES/OBJECTS
 - INEXPENSIVE, EASY TO PRODUCE
 - INTELLIGENT (RESPONSIVE, ADAPTIVE)



Copyright 2002-2022 © Marek W. Urban

24

24



Audience Survey Question

ANSWER THE QUESTION ON THE INTERACTIVE SCREEN IN ONE MOMENT

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!**

25

25

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

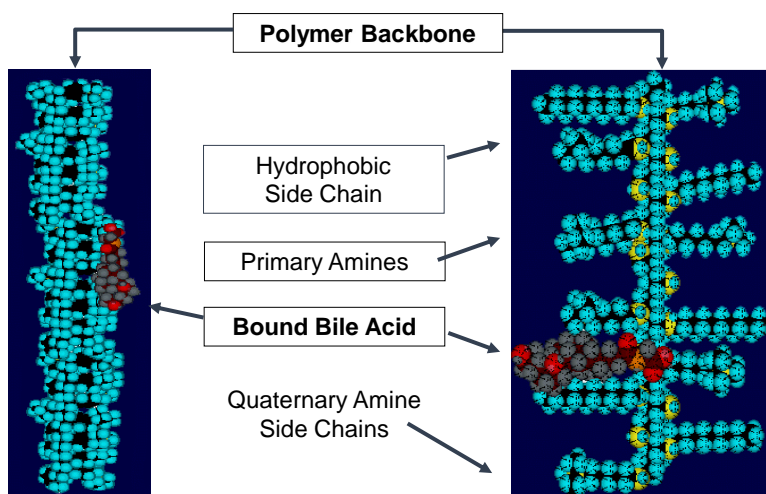
Spectroscopic Approaches
 Thermomechanical Approaches
 Macroscopic Testing

COATING
SUBSTRATE



26

Molecular Design

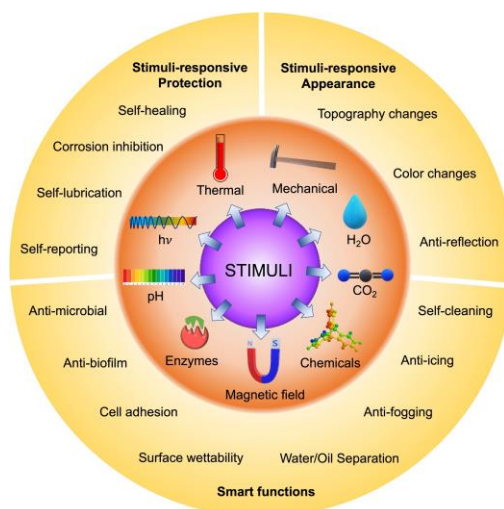


Copyright 2002-2022 © Marek W. Urban

27

27

PHYSICO-CHEMICAL STIMULI THAT MAY BE INCORPORATED INTO POLYMERIC COATINGS



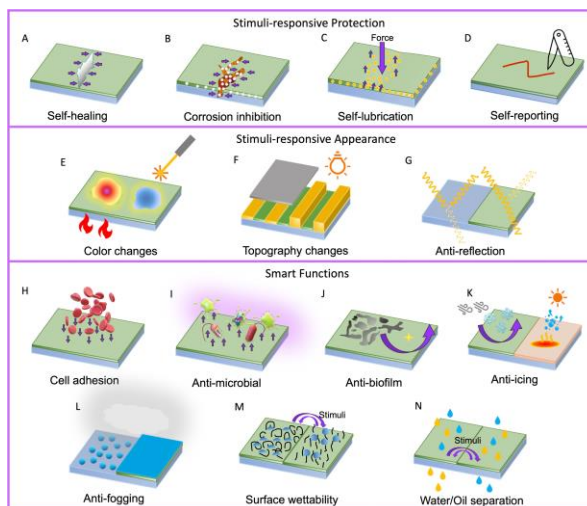
Stimulus-Responsive Macromolecules in Polymeric Coatings; <https://doi.org/10.1080/15583724.2022.2065299>

Copyright 2002-2022 © Marek W. Urban

28

28

STIMULI-RESPONSIVENESS IN MODERN COATINGS APPLICATIONS



Stimulus-Responsive Macromolecules in Polymeric Coatings; <https://doi.org/10.1080/15583724.2022.2065299>

Copyright 2002-2022 © Marek W. Urban

29

29



Audience Survey Question

ANSWER THE QUESTION ON THE INTERACTIVE SCREEN IN ONE MOMENT

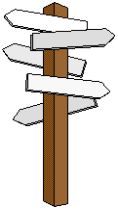
Which of these companies are considered key players in Urethane production?

- 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!**

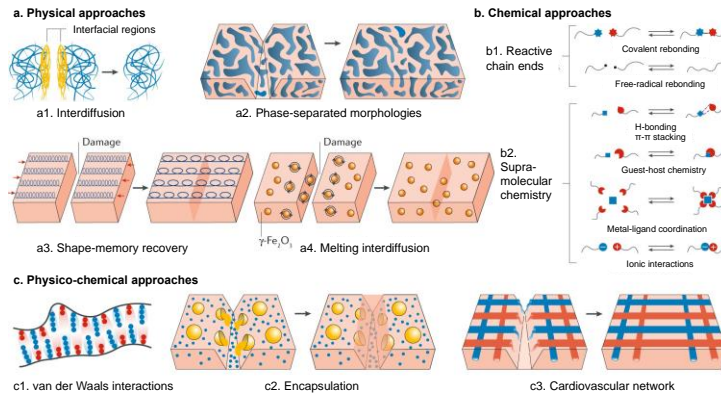
30

30



Future Directions

SELF-HEALABLE POLYMERIC COATINGS



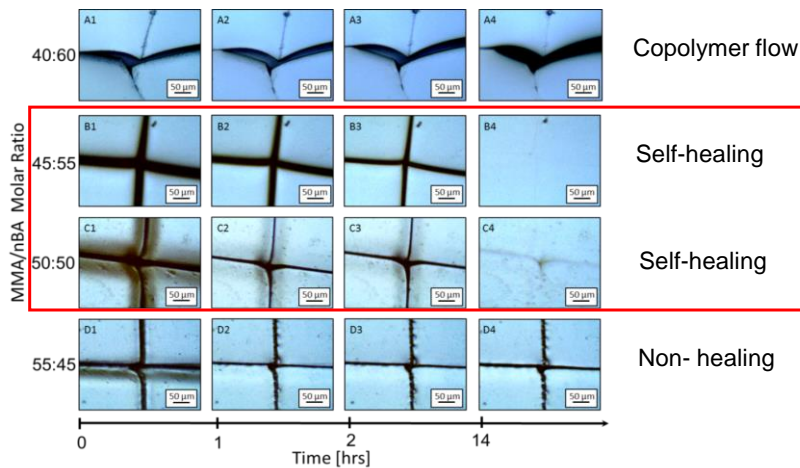
Nature Reviews Materials, 5, 562–583 (2020)

Copyright 2002-2022 © Marek W. Urban

31

31

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



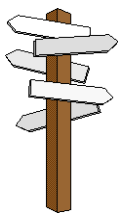
- Self-healing occurs with a narrow compositional range (45/55-50/50 MMA/nBA)
- Higher nBA concentrations cause copolymer flow

Science, 2018, 362(6411), 220-225.

Copyright 2002-2022 © Marek W. Urban

32

32

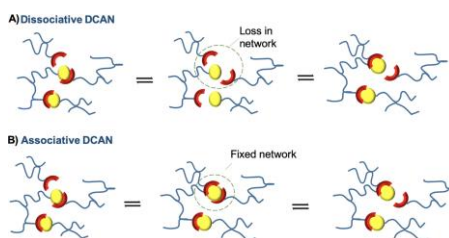


Future Directions

Covalently Adaptable Networks (CANs)

Reprocessable Thermosets

Associative/Dissociative Dynamic Covalent Bonds

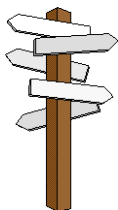


[Chem. Eng. J., 385, 2020, 123820](#)

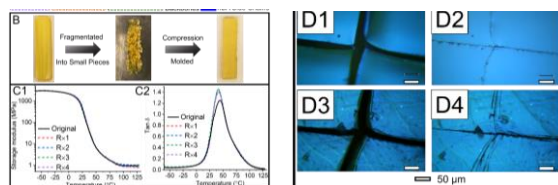
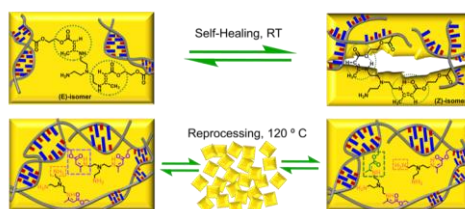
Copyright 2002-2022 © Marek W. Urban

33

33



Combining Self-Healing and CANs



Macromolecules, 2022, in press.

Copyright 2002-2022 © Marek W. Urban

34

34



Audience Survey Question

ANSWER THE QUESTION ON THE INTERACTIVE SCREEN IN ONE MOMENT

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!**

35

35

2022 and Beyond ACS Polymeric Coatings Short Course

FROM FUNDAMENTALS TO FUTURE TECHNOLOGIES

- | | |
|--|--|
| <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • Chap. 13 Additives in Coatings • Chap. 14 Metal and Corrosion Inhibiting Pigments • Chap. 15 Designing Industrial Coatings • Chap. 16 Coatings Common Defects • Chap. 17 Solvents; VOC Regulations • Chap. 18 Exterior Durability • Chap. 19 Practical and Theoretical Adhesion • Chap. 20 Modern Analysis; Structure-Property Relations • Chap. 21 Testing Methods • Chap. 22 Stimuli-Responsive Polymeric Coatings • Chap. 23 Self-Healable and Reprocessable Coatings • Chap. 24 Connecting Fundamental with Future Technologies; Reprocessable Thermosets |
|--|--|

36

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’

Copyright 2002-2022 © Marek W. Urban

37

37



www.acs.org/acswebinars



**THE LIVE Q&A IS
ABOUT TO BEGIN!**

Keep submitting your questions
in the questions window!

38

38

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

39



www.acs.org/acswebinars



Thurs., June 9, 2022 | 2:00pm–3:15pm ET

How to Plan and Organize Your Competitive Research Proposal

Co-produced with Student & Postdoctoral Scholars Office and the Petroleum Research Fund



Wed., June 15, 2022 | 2:00pm–3:30pm ET

How Polymeric Materials Protect Our Armed Forces

Co-produced with ACS Division of Polymer Chemistry



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

Starting a Company: How to Setup Equity and Securities Structures

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

Register for Free

Browse the Upcoming Schedule at www.acs.org/acswebinars

40

40



www.acs.org/acswebinars



Learn from the best and brightest minds in chemistry!

Hundreds of webinars on a wide range of topics relevant to chemistry professionals at all stages of their careers, presented by top experts in the chemical sciences and enterprise.



Edited Recordings

are an exclusive benefit for ACS Members with the Premium Package and can be accessed in the ACS Webinars® Library at www.acs.org/acswebinars



Live Broadcasts

of ACS Webinars® continue to be available free to the general public several times a week generally from 2-3pm ET. Visit www.acs.org/acswebinars to register* for upcoming webinars.

*Requires FREE ACS ID

41

41



www.acs.org/acswebinars



ACS Webinars® does not endorse any products or services. The views expressed in this presentation are those of the presenter and do not necessarily reflect the views or policies of the American Chemical Society.

Contact ACS Webinars® at acswebinars@acs.org



Mike Russell Erik

42

42