

MATERIALS SCIENCE AND TECHNOLOGY NEWSLETTER

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SURFACE MODIFICATION: A VERY APPLIED BUT LITTLE SEEN TECHNOLOGY

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In advance of the upcoming 10th in the symposium series on POLYMER SURFACE MODIFICATION it is apropos that this issue of the NEWSLETTER focus on the topic of surface modification. Surface modification has the unique distinction of being one of the most universally applied technologies in modern industry while at the same time being the least seen. At least one or more surface modification steps are involved in every industrial coating process which gives the technology an extraordinary range of application yet the results are not apparent to the naked eye as surface modification does its work beneath the surface at various critical interfaces insuring the stability of the overlying coating. Yet industrial coatings are only a subset of the range of applications where surface modification technologies come into play. We can go on the mention several other industrial processes such as composites, adhesive joining and biomedical implants where surface modification plays a critical role yet the modified layer remains quite invisible to the observer while nevertheless ensuring the viability of the structure involved. We look into this matter in more detail in the following editorial essay.

We would also like to bring to the reader's attention the following important events which should be of great interest to all who engage in surface modification methods in their ongoing product development or manufacturing activities:

The first is the upcoming SHORT COURSE ON THE CHEMISTRY, PHYSICS AND MECHANICS OF ADHESION SCIENCE scheduled to be given November 5-7, 2014 at the Courtyard by Marriott, Stewart-Newburgh, New York. The topic of surface modification is heavily covered in this course as this technology plays a major role in improving adhesion in a wide range of applications. Further details may be found in the flyer at the end of this newsletter.

The second event is the upcoming TENTH INTERNATIONAL SYMPOSIUM ON POLYMER SURFACE MODIFICATION: RELEVANCE TO ADHESION to be held at the University of Maine, Orono, Maine, June 22-24, 2015. This symposium series attracts leading researchers in the field of polymer surface modification from both industry, research institutes and academia and is of definite interest to all seeking to learn the latest developments in this universally applied technology. Again further details are given at the end of this newsletter.

It occurs to me from time to time that many important technologies and industrial processes that have the most impact on our day to day lives are also among the most obscure and least recognized. Surface modification, especially of polymer materials, is a case in point. Five of the first 6 of the current 9 past symposia on POLYMER SURFACE MODIFICATION: RELEVANCE TO ADHESION have been documented in hard bound volumes¹. A cursory glance through these volumes yielded the following 52 applications of a variety of surface modification methods as applied to products and processes some in quite common use and some of a more esoteric nature. The applications to inks and various coatings are before our eyes every day and are certainly the least appreciated. The bio-medical applications are clearly the more esoteric but have definitely profound consequences for a large segment of the population.

We invite the reader to join us at the 10th in the POLYMER SURFACE MODIFICATION SYMPOSIUM SERIES this coming June to learn about the latest applications and surface modification methods.

BIOMEDICAL APPLICATIONS

1. Tissue culture surfaces to improve cell attachment and cell growth.
2. Contact lenses to enhance tear wettability.
3. Catheter surfaces to reduce friction.
4. Voice prostheses
5. Improved bio compatibility of polymers such as the polyurethanes that have many attractive properties but untreated have poor blood compatibility.
6. Development of bio compatible adhesives for surgical applications
7. Surface modification via grafting for gene-chip applications

¹ The relevant volumes are: POLYMER SURFACE MODIFICATION: RELEVANCE TO ADHESION, ED K. L. Mittal:

VSP, Utrecht, The Netherlands, (1996)
 Volume 2, VSP, Utrecht, The Netherlands, (2000)
 Volume 3, VSP, Utrecht - Boston, (2004)
 Volume 4, VSP, Leiden - Boston (2007)
 Volume 5, VSP, Leiden - Boston (2009)

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| <p>8. Surface modification to control cell adhesion to surgical implants</p> <p>9. Treatment of miniature polymer container arrays to improve compatibility with cell cultures for "lab on a chip" applications</p> <p>10. Modification of fibers for anchoring bacteriostatic or odor binding agents for specialty fabrics or binding medicinal agents for slow release to the skin in medical treatment clothing.</p> <p style="text-align: center;">SURFACE ANTIFOULING AND LIQUID REPELLING APPLICATIONS</p> <p>11. Prevention of ice accumulation.</p> <p>12. Development of water repellent fibers for rain ware</p> <p>13. Anti fogging of optical lenses.</p> <p>14. Treatment of fruits and vegetables to remove pathogens</p> <p>15. Treatment of membranes for desalinization and other water purification applications</p> <p>16. Treatment of membranes in fuel cell applications to improve cation permeability selectivity.</p> <p>17. Creation of superhydrophobic and superhydrophilic surfaces for self cleaning and moisture capture applications</p> <p style="text-align: center;">ADHESION AND ADHESIVE BONDING</p> <p>18. Improve adhesion to low surface energy polymers:</p> <p style="margin-left: 20px;">a. TEFLON
b. POLYETHYLENE
c. POLYPROPYLENE
d. ETC</p> <p>19. Surface treatment to improve adhesion of pressure sensitive adhesives</p> <p>20. Treatment of substrates and adhesives in adhesive joint applications.</p> <p style="text-align: center;">ADHESION AND ADHESIVE BONDING IN SURGICAL APPLICATIONS</p> <p>21. Gastroenterologic surgery</p> <p style="margin-left: 20px;">a. Sealing of esophagus and bile duct</p> | <p>22. Cardiac surgery</p> <p style="margin-left: 20px;">a. Anastomosis and hemostasis of micro blood vessel</p> <p>23. Thoracic Surgery</p> <p style="margin-left: 20px;">a. Sealing of lung air leak</p> <p>24. Neurosurgery</p> <p style="margin-left: 20px;">a. Adhesion and sealing of dura mater</p> <p>25. Gynecology</p> <p style="margin-left: 20px;">a. Anastomosis of fallopian tube</p> <p>26. Orthopedics</p> <p style="margin-left: 20px;">a. Adhesion of bone; Closing skin wound</p> <p>27. Urology</p> <p style="margin-left: 20px;">a. Anastomosis of urinary tube</p> <p style="text-align: center;">COATING AND PRINTING APPLICATIONS</p> <p>28. Surface treatment of insulator layers in microelectronic structures to improve and control:</p> <p style="margin-left: 20px;">a. Adhesion of photo resist layers
b. Interlayer adhesion between different wiring levels</p> <p>29. Improve adhesion of inks to paper.</p> <p>30. Improve adhesion of inks to polymer films.</p> <p>31. Improve adhesion of inks to bulk plastic parts:</p> <p style="margin-left: 20px;">a. Knobs
b. Handles
c. Plastic bottles/containers
d. etc</p> <p>32. Treatment of toner particles for laser printers and copiers</p> <p>33. Improvement of adhesion of metals to polymers for light reflector applications in automotive and lighting industries</p> <p>34. Improved adsorption of dyes to fibers and fabrics</p> <p>35. Improving shrink resistance of wool</p> <p>36. Treatment of natural fibers such as jute, flax, hemp etc for use in composites</p> <p>37. Improved fiber properties for use as ropes, cables, sporting equipment, airbags</p> <p>38. Improvement of weldability of polymers such as polypropylene</p> |
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39. Enhance adsorption of water to fibers for use as towels

40. Improve adhesion of coatings to lenses and face shields in a wide variety of optical applications

41. Surface modification of rubbers in foot ware industry

42. Surface modification of rubbers in building industry for window seals, carpeting, noise insulation

43. Surface modification of reinforcing cords in automobile tires for improved adhesion

44. Surface modification of reinforcing phases in composites:

- a. Fiberglass-epoxie
- b. Carbon fiber- epoxie
- c. Particle fillers in wide range of particle/polymer composites

45. Fabrication of specialty papers by blending synthetic polymer fibers with wood pulps

MISCELLANEOUS APPLICATIONS

46. Polymer surface modification for decorative coatings

47. Improving gas barrier properties for food product packaging

48. Surface modification of MYLAR for magnetic tapes

49. Modification of epoxy boards for printed circuits

50. Surface modification of TEFLON for improved metal adhesion in microelectronic laminates

51. Tailoring of membrane overlays for instrument clusters and graphic arts applications

52. Surface treatment for more precise control of lithographic processes

CALL FOR PAPERS

Tenth International Symposium on POLYMER SURFACE MODIFICATION

RELEVANCE TO ADHESION

To be held at the University of Maine
Orono, Maine USA
June 22-24, 2015

SYMPOSIUM HISTORY AND MOTIVATION

This symposium tenth in the series which continues the tradition set by the first in the series entitled: "Polymer Surface Modification: Relevance to Adhesion" which was held in Las Vegas, NV, 1993. As with its predecessors, this symposium will be concerned with the technological areas where surface modification is a key technology which allows for the processing and manufacture of products which would otherwise be unobtainable. Also this meeting will expand the scope of polymer surfaces being investigated by including biopolymer materials with applications including forest products, medical implants and food processing.

Typically the surface modification techniques covered in this meeting are intended to alter the surface chemistry in order to improve wetting properties and the adhesion of coatings. In addition, modification methods such as atmospheric plasma are being used to remove surface contaminants which include particles, greases and pathogens. A key element of all of these methods though is the modification of only a thin surface layer leaving the bulk properties of the material unaltered.

AUDIENCE AND PARTICIPATION

This symposium is organized to bring together scientists, technologists, managers and engineers interested in all aspects of polymer surface modification, to review and assess the current state of knowledge, to provide a forum for exchange and cross-fertilization of ideas, and to define problem areas which need intensified efforts.

SUBMITTING A PAPER

This symposium is being organized by MST Conferences under the direction of Dr. K. L. Mittal, Editor, Reviews of Adhesion and Adhesives. Please notify the conference chairman of your intentions to present a paper as early as possible. An abstract of

about 200 words should be sent by January 31, 2015 to the conference chairman by any of the following methods:

E-mail: rhl@mstconf.com
FAX: 212-656-1016

ONLINE: www.mstconf.com/resp-sprg-2015.htm

REGULAR MAIL:

Dr. Robert H. Lacombe
Conference Chairman
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Hopewell Junction, NY 12533, USA

Contact by phone: 845-897-1654; 845-227-7026
Full conference details and registration via the Internet will be maintained on our web site:
www.mstconf.com/surfmod10.htm

AMONG TOPICS TO BE COVERED ARE:

SURFACE MODIFICATION TECHNIQUES

- ▶ RADIATION METHODS
 - a. Low Pressure Plasma
 - b. Atmospheric Plasma
 - c. Corona Discharge
 - d. Flame
 - e. Laser
 - f. Ultraviolet

- ▶ CHEMICAL TREATMENT
 - g. Monolayer Deposition
 - h. Grafting
 - i. Wet Chemical

POLYMER SURFACE MODIFICATION TO ENHANCE ADHESION OF:

- ▶ Metal layers (metallized plastics)
- ▶ Organic Coatings
 - j. Paints
 - k. Inks
 - l. Primers
- 53. Adhesive Joints
- 54. Composites
 - a. Glass
 - b. Carbon Fiber

- c. Wood

SURFACE MODIFICATION OF BIOPOLYMERS

- 55. Food Products
 - a. Vegetables, Berries
 - b. Seeds
 - c. Bioadhesives

APPLICATIONS

- ▶ Packaging, Composites
- ▶ Food, Agriculture
- ▶ Biomedical Applications
 - i. implants
 - ii. sterilization
 - iii. improved cell adhesion
- ▶ Microelectronics, aerospace, marine...

SURFACE CHARACTERIZATION

- ▶ All Methods for Characterization of Treated Surfaces:
 - ▶ Infrared/Raman spectroscopy
 - ▶ XPS, SIMS, SEM...
 - ▶ Atomic Force Microscopy
 - ▶ Contact Angle

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[SUBMIT RESPONSE FORM TO GET ON MAILING LIST TO RECEIVE UPDATED INFORMATION ON THIS SYMPOSIUM](#)

www.mstconf.com/resp-sprg-2015.htm
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3- Day Impact Course The Chemistry, Physics & Mechanics of Adhesion Science

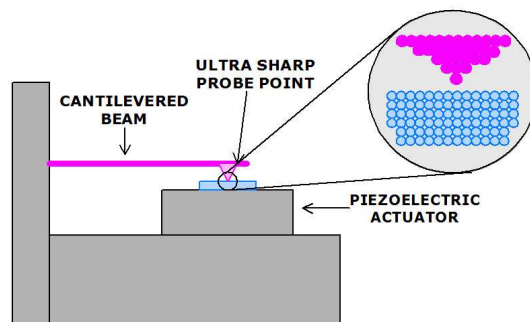
November 5-7, 2014
 Courtyard by Marriott, Stewart-
 Newburg New York
 SCENIC HUDSON VALLEY

Topics to be Covered

- I. Surface Contamination and Cleaning
- II. Theories or Mechanisms of Adhesion
- III. Contact Angle, Wettability and Adhesion
- IV. Investigation of Interfacial Interactions
- V. Surface Modification Techniques including Plasma
- VI. Ways to improve Adhesion of Organic Coatings
- VII. Silanes and Other Adhesion Promoters

SCHMATIC OF ATOMIC FORCE MICROSCOPE

V



- IX. Adhesion Measurement of Films and Coatings
- X. Basics of Adhesion Measurement
- XI. Residual Stress and Material Mechanical Properties
- XII. Setting Adhesion Requirements for Coating Applications
- XIII. Adhesion Measurement at Atomic and Molecular Level
- XIV. Fundamental Adhesion Applications

How You Will Benefit From This Course

You will understand advantages and disadvantages of a range of adhesion measurement techniques. You will be able to select the right surface cleaning technique including the use of atmospheric plasma. You will utilize the concept of acid-base interactions in improving adhesion, acquire basic skills for addressing adhesion failure problem. Analyze the alternatives and select the optimum technique for improving adhesion, and the durability. Know where help is available in emergency situations and learn how to select best measurement technique for a given application.

Audience: Scientists and professional staff in R&D, manufacturing, processing, quality control/reliability involved with adhesion aspects of coatings and adhesion sensitive applications.

Level: Beginner- Intermediate; introduction/overview

Prerequisites: Elementary background in chemistry, physics or materials science.

Duration: 3 days

Course fee and materials: \$1,295, includes break refreshments, complete set of lecture notes and copy of handbook and reference guide ADHESION MEASUREMENT METHODS: THEORY AND PRACTICE, (CRC PRESS, 2006)

Adhesion's Important Role Today

Adhesion plays an important role in many technologies and industries, viz., aerospace, microelectronics, automotive, thin films, optics, coatings, paint and so on. Broadly speaking, the topic can be divided into two categories: film or coating/ substrate combination, and adhesive joint. Films and coating are used for a variety of purposes and irrespective of their intended function, these must adhere adequately to the underlying substrate. So the need for understanding and controlling the factors affecting adhesion is quite patent.

Furthermore, the durability of the bond (on exposure to process chemicals, moisture, corrosives, etc.) is of grave concern and importance. This course presents an overview of the chemistry, physics and mechanics of adhesion in regard to understanding fundamental adhesion mechanisms. You will learn how to improve and control them and the latest adhesion measurement techniques which

are being used to evaluate the PRACTICAL ADHESION of coatings and laminate structures.

Emphasis is given to methods which can be carried out in a manufacturing environment as well as in the lab environment; which give results that are directly relevant to the durability and performance of the structures under investigation. The effects of coating elastic properties and residual stress are considered as well as other external influences which affect durability under use conditions.

INSTRUCTORS AND CONTACT INFORMATION

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rhl@mstconf.com

For detailed information and registration:
www.mstconf.com/AdhesionCourse.htm