SURFACE MODIFICATION: A VERY APPLIED BUT LITTLE SEEN TECHNOLOGY

EDITORIAL COMMENTS ................................................................. 2
52 APPLICATIONS OF SURFACE MODIFICATION ................................ 2
Tenth International Symposium on
POLYMER SURFACE MODIFICATION

RELEVANCE TO ADHESION ....................................................... 4
SYMPOSIUM HISTORY AND MOTIVATION ..................................... 4
AUDIENCE AND PARTICIPATION ................................................ 4
SUBMITTING A PAPER ............................................................... 4
AMONG TOPICS TO BE COVERED ............................................. 5
ORGANIZERS AND CONTACT INFORMATION ................................. 5

3- Day Impact Course
THE CHEMISTRY, PHYSICS & MECHANICS
OF ADHESION SCIENCE ............................................................. 6
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 to 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.

---

**52 APPLICATIONS OF SURFACE MODIFICATION**

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 volumes. 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:

Volume 4, VSP, Leiden - Boston (2007)
Volume 5, VSP, Leiden - Boston (2009)
8. Surface modification to control cell adhesion to surgical implants

9. Treatment of miniature polymer container arrays to improve compatibility with cell cultures for "lab on a chip" applications

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.

SURFACE ANTIFOULING AND LIQUID REPELLENT APPLICATIONS

11. Prevention of ice accumulation.

12. Development of water repellent fibers for rainware

13. Anti fogging of optical lenses.

14. Treatment of fruits and vegetables to remove pathogens

15. Treatment of membranes for desalination and other water purification applications

16. Treatment of membranes in fuel cell applications to improve cation permeability selectivity.

17. Creation of superhydrophobic and superhydrophilic surfaces for self cleaning and moisture capture applications

ADHESION AND ADHESIVE BONDING

18. Improve adhesion to low surface energy polymers:
   a. TEFLON
   b. POLYETHYLENE
   c. POLYPROPYLENE
   d. ETC

19. Surface treatment to improve adhesion of pressure sensitive adhesives

20. Treatment of substrates and adhesives in adhesive joint applications.

ADHESION AND ADHESIVE BONDING IN SURGICAL APPLICATIONS

21. Gastroenterologic surgery
   a. Sealing of esophagus and bile duct

22. Cardiac surgery
   a. Anastomosis and hemostosis of micro blood vessel

23. Thoracic Surgery
   a. Sealing of lung air leak

24. Neurosurgery
   a. Adhesion and sealing of dura mater

25. Gynecology
   a. Anastomosis of fallopian tube

26. Orthopedics
   a. Adhesion of bone; Closing skin wound

27. Urology
   a. Anastomosis of urinary tube

COATING AND PRINTING APPLICATIONS

28. Surface treatment of insulator layers in microelectronic structures to improve and control:
   a. Adhesion of photo resist layers
   b. Interlayer adhesion between different wiring levels

29. Improve adhesion of inks to paper.

30. Improve adhesion of inks to polymer films.

31. Improve adhesion of inks to bulk plastic parts:
   a. Knobs
   b. Handles
   c. Plastic bottles/containers
   d. etc

32. Treatment of toner particles for laser printers and copiers

33. Improvement of adhesion of metals to polymers for light reflector applications in automotive and lighting industries

34. Improved adsorption of dyes to fibers and fabrics

35. Improving shrink resistance of wool

36. Treatment of natural fibers such as jute, flax, hemp etc for use in composites

37. Improved fiber properties for use as ropes, cables, sporting equipment, airbags

38. Improvement of weldability of polymers such as polypropylene
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 footwear 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-epoxy
   b. Carbon fiber-epoxy
   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 TEFLOM 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  


**REGULAR MAIL:**

Dr. Robert H. Lacombe  
Conference Chairman  
3 Hammer Drive  
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

**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

**ORGANIZERS AND CONTACT INFORMATION:**

Dr. K .L. Mittal, Director  
1983 Route 52, Suite C  
P.O. Box 1280  
Hopewell Junction, NY 12533-1280  
Tel. 845-897-1654  
FAX: 845-897-2361  
E-mail: klm@mstconf.com

Dr. R. H. Lacombe  
Conference Chairman  
3 Hammer Drive  
Hopewell Junction, NY 12533  
Tel. 845-227-7026  
FAX: 212-656-1016  
E-mail: rhl@mstconf.com

Dr. Douglas J. Gardner  
University of Maine  
5769 South Annex B  
Composites Center  
Orono, ME 04469  
Tel. 207-581-3888  
FAX. 207-581-2074  
Email: douglasg@maine.edu
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
VIII. Adhesion Aspects of Thin Films
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

Dr. K. L. Mittal & Dr. R. H. Lacombe
3 Hammer Drive
Hopewell Junction, NY 12533
Tel. 845-897-1654 & 845-227-7026

E-mail: klm@mstconf.com; rhl@mstconf.com

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