

MATERIALS SCIENCE AND TECHNOLOGY NEWSLETTER

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FOCUSING ON SURFACE RELATED ASPECTS OF MATERIALS SCIENCE AND CLEANING

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Dr. Robert H. Lacombe, Chairman and Newsletter Editor

WELCOME MESSAGE FROM DIRECTOR AND CHAIRMAN

Welcome to the first issue of the MATERIALS SCIENCE AND TECHNOLOGY NEWSLETTER, a publication of MST CONFERENCES, LLC. MST CONFERENCES is devoted to sponsoring topical symposia for the international community of scientists, engineers and technical managers on subjects of critical interest to both the academic and industrial communities. During the year 1999 six symposia were held dealing with coating technologies, surface phenomena and adhesion related subjects. Nearly all MST symposia deal with surface related phenomena of one form or another.

Primary conference objectives: The primary goal of each of the symposia is to provide a forum for investigators throughout the international community whereby state of the art technologies can be reviewed and the latest breakthroughs can be presented and critically analyzed. The defining criteria for an MST symposium are as follows:

- All meetings are devoted to a single topic of central interest in both academic and industrial circles. The meetings are small with no parallel sessions.
- Invited speakers are among the leading experts in their respective fields who are actively publishing in the technical literature and carrying out both fundamental and applied research.
- All symposia are documented by in the form of archival transactions volumes which are rigorously peer reviewed and edited to a level equal to or greater than standard technical and scientific journals.
- The success of each symposium is evaluated by the degree of interaction which is fostered among all participants. Lively and informative discussions have been one of the hallmarks of past conferences.

Brief history of conference origins: The principles of MST CONFERENCES come from a background in the microelectronics industry where problems of surfaces, interfaces and cleaning are not only ubiquitous but also critical to the technical and commercial success of microelectronic structures such as semiconductor chips, ceramic packages and circuit boards which are the mainstays of the industry. This environment provided a very fertile ground for creating problems related to surfaces, interfaces and cleaning. It was in this milieu that MST's director Dr. Mittal was inspired to organize over 27 international symposia dealing with these topics. MST thus has very deep roots within its realm of interest. Dr. Lacombe, the Conference Chairman, has been a long time friend and coworker with Dr. Mittal during the early days in the microelectronics industry. Whereas, Dr. Mittal was primarily a man of the library dealing with the vast technical literature on surface phenomena, Dr. Lacombe was more the man of the laboratory dealing with experiments relating to thin films, their thermal-mechanical properties and their adhesion to one another. MST is thus a collaboration of two scientists with highly complimentary backgrounds and skills who have formed MST not only to further pursue their technical interests in the field of surface science and technology but at the same time provide a service to the worldwide technical community to which they have belonged for their entire working careers.

Past symposia: The inaugural conference in the current series was held in October 1988 at which time MST CONFERENCES did not exist as a formal organization. Two symposia were held dealing with Acid-Base Interactions and Silane Adhesion Promoters. There were upwards of 80 participants at each of these symposia including both speakers and attendees. The overall response to these symposia was so strongly positive that the organizers decided to sponsor future symposia in the same vein under the agency of MST CONFERENCES. Thus, during 1999 six further symposia were held dealing with the following topics:

- ▶ SECOND INTERNATIONAL SYMPOSIUM ON POLYMER SURFACE MODIFICATION: RELEVANCE TO ADHESION; May 24-26, 1999
- ▶ SECOND INTERNATIONAL SYMPOSIUM ON PLASMA POLYMERIZATION/DEPOSITION: FUNDAMENTAL AND APPLIED ASPECTS; May 27-28, 1999
- ▶ SECOND INTERNATIONAL SYMPOSIUM ON ADHESION MEASUREMENT OF THIN FILMS AND COATINGS; October 25-27, 1999
- ▶ INTERNATIONAL SYMPOSIUM ON ADHESION ASPECTS OF THIN FILMS; October 28-29, 1999
- ▶ INTERNATIONAL SYMPOSIUM ON POLYIMIDES AND OTHER HIGH TEMPERATURE POLYMERS: SYNTHESIS, CHARACTERIZATION AND APPLICATIONS; November 29 - December 1, 1999
- ▶ SEVENTH INTERNATIONAL SYMPOSIUM ON METALLIZED PLASTICS: FUNDAMENTAL AND APPLIED ASPECTS; December 2-3, 1999
- ▶ SECOND INTERNATIONAL SYMPOSIUM ON ADHESIVE JOINTS: FORMATION, CHARACTERISTICS AND TESTING; May 22-24, 2000
- ▶ SECOND INTERNATIONAL SYMPOSIUM ON ADHESION ASPECTS OF POLYMERIC COATINGS; May 25-26, 2000
- ▶ SEVENTH INTERNATIONAL SYMPOSIUM ON PARTICLES ON SURFACES: DETECTION, ADHESION AND REMOVAL; June 19-21, 2000
- ▶ SECOND INTERNATIONAL SYMPOSIUM ON CONTACT ANGLE, WETTABILITY AND ADHESION; June 21-23, 2000

For each of the above symposia a proceedings volume is either in press or in preparation.

Current and future symposia: During the calendar year 2000, MST will be sponsoring 8 new symposia again covering a broad range of topics but all closely related to material properties, surface phenomena and adhesion. The calendar of events is as follows:

MST CONFERENCE SCHEDULE FOR YEAR 2000

DATE	TOPIC
October 9-11, 2000	INTERNATIONAL SYMPOSIUM ON POLYMER SURFACE CHARACTERIZATION
October 11-13, 2000	INTERNATIONAL SYMPOSIUM ON POLYMERS IN MICROELECTRONICS
Nov. 27 -29, 2000	INTERNATIONAL SYMPOSIUM ON ADHESIVES: SYNTHESIS, CHARACTERIZATION AND APPLICATIONS
Nov. 30 - Dec. 1, 2000	INTERNATIONAL SYMPOSIUM ON INTERFACES IN POLYMER COMPOSITES

TECHNICAL ISSUES: In this section of the newsletter we plan to comment on topics of universal interest to the symposium series. We also cordially invite readers to give their comments which will be published in subsequent issues. The topic for this issue is the question of terminology with regard to adhesion and adhesion measurement.

What Precisely do we Mean by Adhesion: The field of adhesion has generated a vocabulary of its own and unfortunately not everyone uses the terminology in the same manner. This can lead to confusion and misunderstanding in the literature. The problems of adhesion are quite complex enough in their own right and there is no need for the further complexity which is introduced through imprecise terminology. In this column, therefore, we would like to try and forge a consensus of usage at least in regard to certain commonly used terms. In particular we would like to focus on the terms "practical adhesion" and "fundamental adhesion". These terms were first used by K. L. Mittal in 1975 where he also discussed in detail the relationship between these two quantities. The field of adhesion enjoys the unique distinction of being both a very sticky subject and a very slippery one at the same time. It is sticky in regard to the consequences of the atomic and molecular interactions involved and slippery in regard to the number of errors and

misconceptions which arise due to the highly complex nature of the aforementioned interactions. Take, for example, the common peel test for a flexible coating on a rigid substrate. This experiment gives a straightforward measure of how well the coating is adhered to the substrate in terms of the directly measured peel force. We would call this peel force a measure of the "practical adhesion" of the coating to the substrate. So what is the problem? Why do we need any further terminology to describe the adhesion of the coating to the substrate? The best answer to this question can be found in the interesting paper by Farris and Goldfarb ("*An Experimental Partitioning of the Mechanical Energy Expended During Peel Testing*", in *Adhesion Measurement of Films and Coatings*, K. L. Mittal, Ed. (VSP, 1995) pp. 265 - 281). These investigators did extensive peel testing on polyimide coatings on aluminum substrates. For a film thickness of 120µm their peel test data estimates an adhesion strength of about 500J/m². However, at this thickness these films are known to spontaneously delaminate at the edges due to intrinsic stresses at a driving force of only 23J/m². In this case we see that the simple peel test over estimates the actual adhesion strength of the coating by over an order of magnitude in regard to one of the most common delamination mechanisms for coatings. Clearly anyone interested in the adhesion of coatings with internal stresses present has to be very wary of relying on the simple peel test.

We will try to sort out some of this in future issues of the NEWSLETTER and also go further into the issue of "practical" vs "fundamental" adhesion. In the meanwhile we would encourage readers who are interested to pass their views on this subject to the author preferably via E-mail at (rhl@mstconf.com).

CLEAN SURFACE TECHNOLOGY: ADHESION ISSUES: As pointed out in the opening remarks of this newsletter the topics of surface properties and adhesion form a common thread in nearly all of the symposia sponsored by MST CONFERENCES. So it is with the series of symposia on surface cleaning and contamination which the conference Director Dr. Mittal has pursued since the first symposium which was held in San Francisco in 1986. The seventh symposium in the series was held in Newark NJ and the proceedings volume for the 5th and 6th symposia is now available ("*Particles on Surfaces 5&6: Detection, Adhesion and Removal*", K. L. Mittal, Ed., VSP, Utrecht, The Netherlands 1999).

Particle adhesion is becoming a major issue for the semiconductor industry which is now routinely fabricating structures on the order of 0.25 µm and is thus having to deal with microparticle contamination down to the 0.1 µm level. The details of the problem are outlined in a most interesting paper by Genut et al. ("*Chemically Assisted Laser Removal of Photoresist and Particles from Semiconductor Wafers*", *Ibid*, pp 289-296). These authors point out that wafer cleaning is already accounting for more than 30% of the total fabrication steps in advanced production lines. The adhesion of the sub micron contamination is thus becoming a serious issue due to the nature of the forces acting on a particle during the cleaning process. For particles in the sub micron range the adhesion forces to the substrate are primarily of the van der Waals type. Because of this, the interaction force is proportional to the particle diameter D. Particle removal forces due to impinging jets or other fluid flows are proportional to D² and the force due to gravity or other body forces such as the centrifugal force in an ultracentrifuge are proportional to D³. Thus as the particle size decreases the removal forces go down faster than the adhesion forces. The ratio between the adhesion force and the body forces increases as 1/D². The analogous ratio between the adhesion force and the drag forces in fluid flow increases as 1/D. Thus, because of this elementary geometrical effect, the details of the molecular and atomic forces which give rise to particle adhesion are of much more significance in the microparticle regime. This fact has given rise to the use of laser radiation, high speed droplets and other novel techniques for particle removal. All of these methods are discussed in more detail in the above-mentioned proceedings volume.

A second adhesion related issue for contamination removal arises in the cleaning of optical lenses. Fang and Shah ("*The Effect of Various Surfactants on Adhesion of Fine Particles to Polycarbonate Lenses and the Scratches Produced During Wiping Process*", *ibid*, pp 107-115) have carried out an interesting study in which they point out the markedly different effects which surfactants can have on particle adhesion depending on whether the surfactant is anionic or cationic

in nature. It turns out that lenses treated with an anionic surfactant tend to attract far fewer particles than those treated with the cationic variety. Apparently in the anionic case the particles experience a Coulombic repulsion from the lens surface, whereas the cationic surface experiences the opposite Coulombic attraction.

What has been discussed above deals strictly with particles. It is clear, however, that for contamination arising from films, greases, stains ... etc. the issue of contaminant/substrate adhesion is even more critical. Thus adhesion is and will remain a fundamental and practical issue in clean surface technology into the indefinite future.

CALL FOR PAPERS 2000/2001

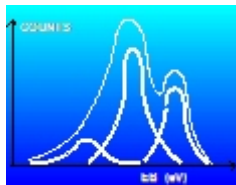
MST CONFERENCES is sponsoring 8 symposia in the year 2000 and 8 more in 2001. The specifics of each symposium for the Fall of 2000 and all of 2001 are listed below. Each of these symposia is organized to bring together scientists, technologists and engineers interested in all aspects of the topic being discussed, 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.

The invited speakers have been selected so as to represent widely differing disciplines and interests, and they hail from academic, governmental and industrial research laboratories. Each meeting is planned to be a truly international event both in geographic coverage as well as in spirit. The technical program will contain both invited overviews and contributed original research papers. It is planned to chronicle the transactions of each in a hard-bound volume of archival quality (to match or exceed the standards of the journal literature) which will serve as a reference work for future generations of investigators.

Anyone interested in presenting a paper or simply attending any one of these symposia should send in the reader response form at the end of this newsletter or go to the conference web site at (www.mstconf.com) and submit the appropriate online response form.

CALL FOR PAPERS: INTERNATIONAL SYMPOSIUM ON POLYMER SURFACE CHARACTERIZATION; To be held October 9-11, 2000 at the Robert Treat Hotel; Newark, NJ

The study of polymer surfaces is important from both fundamental and applied points of view. The number of applications dependent on polymer surface properties are legion, and the areas where polymer surfaces are of critical importance and concern range from microelectronics to prosthetics.



Among the topics to be covered are:

- ▶ Preparation of Polymer Surfaces
- ▶ Physical Characterization of Polymer Surfaces
- ▶ Chemical Characterization of Polymer Surfaces using all Relevant Techniques, Particularly Spectroscopic
- ▶ Leading edge instrumentation including Atomic Force Microscopy, Scanning Tunneling Microscopy and related techniques

▶ APPLICATIONS:

1. Adsorption at Polymer Surfaces
2. Tribological Properties of Polymers
3. Reactions at Polymer Surfaces
4. Surface Energetics and Adhesion of Polymers
5. Polymer Surface Modification
6. Cracking of Polymer Surfaces
7. Biomedical applications

CALL FOR PAPERS: INTERNATIONAL SYMPOSIUM ON POLYMERS IN MICROELECTRONICS; To be held October 11-13, 2000 at the Robert Treat Hotel; Newark, NJ

Polymeric materials have been an integral part of the electronics industry since its inception. The earliest applications were for wire insulation and protective coatings. With the coming of the revolution fostered by integrated circuits the applications of polymers in electronics exploded into a variety of areas including: photoresists, dielectric layers, encapsulates, circuit boards, multichip modules, underfill materials, thermal compounds and passivation layers. One of the primary goals of this symposium will be to provide a forum for discussion of various ramifications of the myriad applications which have arisen in the last 20 years.



Among the topics to be covered are:

- ▶ **Packaging applications:** circuit boards, multichip modules, binders for ceramic processing and thermal compounds, dielectrics for thin film wiring
- ▶ **Chip scale applications:** low dielectric insulators, gap filling, underfill materials, encapsulates for reliability without hermeticity

Processing and reliability issues:

- a. Adhesion
- b. Fracture/crazing
- c. Solvent uptake
- d. Penetrant diffusion
- e. Corrosion

Performance characteristics:

- a. High temperature materials
- b. Low dielectric materials
- c. Conducting polymers
- d. Photo-emitting materials
- e. Photoresists

CALL FOR PAPERS: INTERNATIONAL SYMPOSIUM ON ADHESIVES: SYNTHESIS, CHARACTERIZATION AND Applications; Nov. 27-29, 2000, Robert Treat Hotel; Newark, NJ

The earliest adhesives were resinous materials derived from plants and animals and found most of their applications in bonding paper and wood where only a temporary bond was required or where high strength was not needed. Modern day adhesives however have become indispensable for high performance applications such as military aircraft where durability and light weight are primary concerns.



TOPICS OF INTEREST INCLUDE:

- ▶ Chemistry, synthesis and characterization of adhesive formulations
- ▶ Interfacial aspects

PHYSICO-CHEMICAL PROPERTIES

- ▶ Thermal-mechanical properties
- ▶ Rheological properties
- ▶ Adhesion properties and adhesion improvement
- ▶ Effects of aging and environment on long term stability, reliability and durability

CHARACTERIZATION AND TESTING

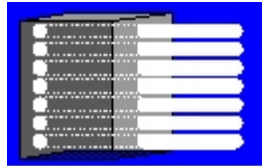
- ▶ Adhesion strength
- ▶ Fracture toughness

APPLICATIONS

- ▶ Pressure sensitive adhesives
- ▶ Specialty adhesives
- ▶ Biomedical adhesives
- ▶ Adhesives for composites/building materials, aerospace, automotive, marine,... etc.

CALL FOR PAPERS: INTERNATIONAL SYMPOSIUM ON INTERFACES IN POLYMER COMPOSITES; To be held Nov. 30 - Dec. 1, 2000 at the Robert Treat Hotel; Newark, NJ

Composites are more and more becoming the materials of choice for a wide range of applications in the modern economy. Everything from sporting equipment to high performance aircraft are being fabricated from composites since only these materials can meet all the desired performance requirements. However, it is well known that the performance of any given composite is critically dependent on the adhesion of the matrix to the reinforcing filler (particle, fabric or fiber).



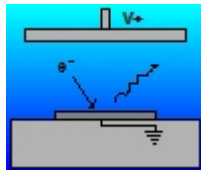
AMONG THE TOPICS TO BE COVERED ARE:

- ▶ Preparation of Polymer Interfaces
- ▶ Physical Characterization of Polymer Interfaces
- ▶ Chemical Characterization of Polymer Interfaces using all Relevant Techniques, Particularly Spectroscopic
- ▶ Fracture mechanics and testing of polymer composite interfaces
- ▶ Effects of aging and environment on polymer composite interfaces
- ▶ Adhesion properties and adhesion improvement
- ▶ Chemistry of polymer composite interfaces
- ▶ Physics and mechanics of polymer composite interfaces
- ▶ Investigation of interfacial interactions between matrix and reinforcing filler

SYMPOSIA FOR 2001

CALL FOR PAPERS: THIRD INTERNATIONAL SYMPOSIUM ON POLYMER SURFACE MODIFICATION: RELEVANCE TO ADHESION; To be held May 21-23, 2001 at the Robert Treat Hotel; Newark, NJ

This symposium 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.



AMONG THE TOPICS TO BE COVERED ARE:

SURFACE MODIFICATION TECHNIQUES

- ▶ Plasma, ultraviolet, corona and laser irradiation
- ▶ Ion beam and flame processing
- ▶ Mechanical roughening
- ▶ Monolayer deposition, grafting and wet chemical

POLYMER SURFACE MODIFICATION FOR ADHESION IMPROVEMENT OF:

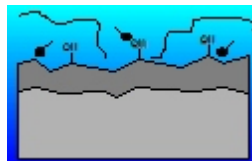
- ▶ Metal layers (metallized plastics)
- ▶ Organic coatings, inks, composites, microorganisms

APPLICATIONS AND SURFACE CHARACTERIZATION

- ▶ Packaging, composites, biological implants
- ▶ Microelectronics, aerospace, marine... etc.
- ▶ All methods for characterization of surface chemistry and morphology, (ESCA, SIMS, AFM ...etc)

CALL FOR PAPERS: INTERNATIONAL SYMPOSIUM ON SURFACE CONTAMINATION AND CLEANING; To be held May 24-25, 2001 at the Robert Treat Hotel; Newark, NJ

This symposium continues the tradition set by its progenitor "Surface Contamination: Genesis, Detection and Control" which was held in Washington DC in 1978. As with its predecessor, this symposium will be concerned with the technological areas



where surface cleaning is of cardinal importance such as adhesion, composites, adsorption, friction, lubrication, soldering, device fabrication and precision machine parts to name just a few where surface contamination has always been a fiendish adversary. **Both particulate and film type contaminants will be covered. Finally, cleaning methods for all kinds of surfaces (glass, metals, plastics,... etc.) are within the purview of this symposium.**

Among the topics to be covered are:

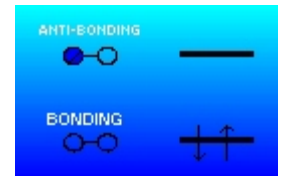
- ▶ Sources, forms and mechanisms of surface contamination
- ▶ Detection, analysis, characterization and control of contaminants
- ▶ Surface cleaning techniques
- ▶ Atomically clean surfaces
- ▶ Surface inspection methods including ESCA, SIMS, ISS, Atomic Force Microscopy, Scanning Tunneling Microscopy and related techniques

APPLICATIONS:

1. Cleaning plastic surfaces
2. Cleaning machine parts, optics
3. Semiconductor manufacturing
4. Biomedical applications, cleaning of surgical instruments
5. Aerospace applications, satellites and space vehicles

CALL FOR PAPERS: THIRD INTERNATIONAL SYMPOSIUM ON ACID-BASE INTERACTIONS: RELEVANCE TO ADHESION; To be held June 13-15, 2001 at the Robert Treat Hotel; Newark, NJ

This symposium is the third in a series which began with the first symposium held in June 1990 in honor of the renowned chemist Prof. F. M. Fowkes. There has been a considerable interest in the concept of Acid-Base interactions within the last 25 years or so due to the highly fundamental nature of this topic which touches on nearly all aspects of pure and applied chemistry.

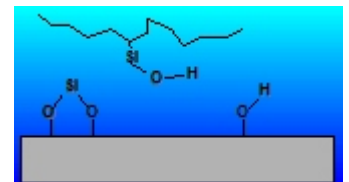


Among the topics to be covered are:

- ▶ Acid-Base characterization.
 - inorganic materials
 - polymeric materials
- ▶ Comparison of acid-base characterization techniques.
- ▶ Fundamental aspects of acid-base interactions.
- ▶ Relevance of acid-base interactions to adhesion.
- ▶ Approaches to measurement of acid-base interactions.
- ▶ Applications:
 - coatings
 - composites/fabrics
 - magnetic inks
 - polymer fillers

CALL FOR PAPERS: THIRD INTERNATIONAL SYMPOSIUM ON SILANES AND OTHER COUPLING AGENTS; To be held June 18-20, 2001 at the Robert Treat Hotel; Newark, NJ

This symposium continues the tradition set by the first symposium in this series: "Silanes and Other Coupling Agents" which was hosted in 1991 by the Dow Corning Corporation in honor of Dr. Edwin P. Plueddemann. As with its predecessor, this symposium will be concerned with the technological areas where the use of surface primers such as silanes is critical to the success of coating technology.



AMONG TOPICS TO BE COVERED ARE:

- ▶ Mechanisms of silanes action.
- ▶ Role of silanes in adhesion of coatings and composites.

- ▶ Deposition techniques:
 - solution
 - plasma
 - vapor
- ▶ Non-silane adhesion promoters.
- ▶ Plasma polymerized coatings as adhesion promoters.
- ▶ Relevance of silanes in durability of bonds.
- ▶ Applications:
 - coatings
 - adhesive joints
 - composites
- ▶ Surface/interface characterization.
 - novel analytical techniques
 - advanced instrumentation

CALL FOR PAPERS: SECOND INTERNATIONAL SYMPOSIUM ON ADHESION ASPECTS OF THIN FILMS: To be held November 5-7, 2001 at the Robert Treat Hotel; Newark, NJ

This symposium is the follow on to the first symposium in this series which was also held in Newark, NJ in 1999. As with its predecessor, this symposium will be concerned with those aspects of thin film technology that have a direct bearing on film adhesion to the substrate. **Both organic and inorganic thin films are of interest irrespective of deposition method.**



TOPICS OF INTEREST INCLUDE:

- ▶ Factors influencing adhesion - Residual stress, mechanical properties, contamination ... etc.
- ▶ Bond durability, corrosion prevention
- ▶ Adhesion promoters

POLYMERIC FILMS

- ▶ Plasma polymerized films
- ▶ Photoresists
- ▶ Organic insulators
- ▶ Barrier layers
- ▶ Effects of aging and environment on adhesion

GENERAL SYSTEMS

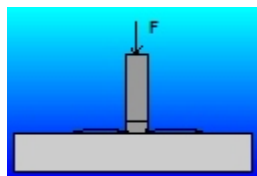
- ▶ Polymer to metal and metal to polymer adhesion
- ▶ Multilevel laminates involving glass, ceramic, metal and polymer thin films

FUNDAMENTAL ISSUES

- ▶ Role of surface chemistry, wettability and morphology
- ▶ Fundamental adhesion mechanisms including film/substrate interactions

CALL FOR PAPERS: THIRD INTERNATIONAL SYMPOSIUM ON ADHESION MEASUREMENT OF THIN FILMS AND COATINGS: To be held November 7-9, 2001 at the Robert Treat Hotel; Newark, NJ

This symposium continues the tradition set by the first symposium in this series which was held in Boston in 1992. As with its predecessor, this symposium will be concerned with the myriad methods for measuring the adhesion of thin films and coatings.



TOPICS OF INTEREST INCLUDE:

- ▶ Adhesion measurements in quality control and manufacturing
- ▶ Adhesion measurements in support of coating process research and development
- ▶ Adhesion measurement instrumentation for laboratory and manufacturing environments

FUNDAMENTAL ASPECTS OF ADHESION MEASUREMENT

- ▶ Mechanics of adhesion testing, the role of film stresses
- ▶ Fracture mechanics of adhesion testing
- ▶ Physico-chemical aspects of adhesion testing, the role of

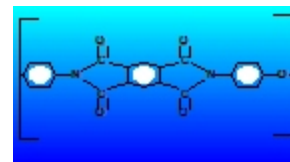
film morphology and chemistry

ADVANCED TEST AND DATA ANALYSIS METHODS

- ▶ Qualitative, semiquantitative and fully quantitative analysis methods.
- ▶ Novel test methods: laser spallation, internal friction, electromagnetic,... etc.
- ▶ Thermodynamic aspects of adhesion testing, (energy flow and balance, calorimetry, ... etc)

CALL FOR PAPERS: SECOND INTERNATIONAL SYMPOSIUM ON POLYIMIDES AND OTHER HIGH TEMPERATURE POLYMERS: SYNTHESIS, CHARACTERIZATION AND APPLICATIONS: To be held December 3-5, 2001 at the Robert Treat Hotel; Newark, NJ

This symposium is the second in a series the first which was held in Newark in 1999. As with its predecessor, this symposium will be concerned with all aspects of polyimides and other high temperature polymers.



TOPICS OF INTEREST INCLUDE:

- ▶ Chemistry, synthesis and characterization of polyimides and other high temperature polymers.
- ▶ Surface chemistry and surface modification

PHYSICO-CHEMICAL PROPERTIES

- ▶ Thermal-mechanical properties
- ▶ Electrical properties
- ▶ Adhesion properties and adhesion improvement
- ▶ Encapsulation and barrier properties
- ▶ Effects of aging and environment on long term stability, reliability and durability

APPLICATIONS

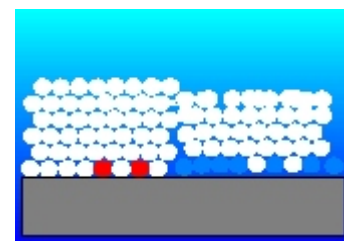
- ▶ Polyimides as adhesives and insulators. Metallization of polyimide coatings.
- ▶ Polyimides as dielectrics, photoresists and encapsulants in microelectronic structures

NOVEL AND ADVANCED FORMULATIONS

- ▶ Ultralow dielectric materials, low thermal expansion liquid crystals, polyimide blends, copolymers, foams,... etc.

CALL FOR PAPERS: EIGHTH INTERNATIONAL SYMPOSIUM ON METALLIZED PLASTICS: FUNDAMENTAL AND APPLIED ASPECTS: To be held December 6-7, 2001 at the Robert Treat Hotel; Newark, NJ

This symposium continues the tradition set by the first symposium in this series which was held in Chicago in 1988. As with its predecessors, this symposium will be concerned with all aspects of metallized plastics. Metallized plastics have become a burgeoning technology with applications ranging from decorative design to optical coatings to advanced thin film wiring schemes in the microelectronics industry.



TOPICS OF INTEREST INCLUDE:

- ▶ Metallization techniques and properties of metal deposits
- ▶ Metal diffusion during deposition
- ▶ Morphology and properties of metal deposits

INVESTIGATION OF INTERFACIAL INTERACTIONS

- ▶ Influence of polymer surface functional groups
- ▶ Metal-polymer interactions
- ▶ Fundamental adhesion mechanisms including coating-substrate interactions

PLASTIC SURFACE MODIFICATION

- ▶ Dry (vacuum) surface treatment of plastics

- ▶ Wet chemical surface treatment of plastics
- ▶ Mechanical surface treatment and cleaning

BASIC PHYSICAL PROPERTIES AND ADHESION

- ▶ Effects of aging and environment on adhesion
- ▶ Mechanical properties and failure mechanisms
- ▶ Diffusion, permeation and barrier properties

SHORT COURSE ON ADHESION MEASUREMENT TECHNIQUES

Associated with each of the above symposia MST gives a short course on adhesion measurement methods. Since nearly all of the symposia have some relation to adhesion phenomena, the ability to quantify the adhesion of two separate materials is clearly one of the unifying themes. This course is designed to mesh with the topical symposia by presenting an overview of the latest adhesion measurement techniques which are being used to evaluate the **PRACTICAL ADHESION** of coatings. Emphasis will be given to methods which can be carried out in a manufacturing environment as well as in the lab and which give results that are directly relevant to the durability and performance of the coatings. The effects of coating elastic properties and residual stress are considered as well as other external influences which affect coating adhesion.

TOPICS INCLUDE:

- ▶ Basics of adhesion measurement:
 - a. Qualitative methods
 - b. Semi-quantitative methods
 - c. Fully quantitative methods

- ▶ Role of residual stress and material mechanical properties on adhesion:
 - a. Effect of coating and substrate elastic properties
 - b. Effect of residual stress
- ▶ Problem of setting adhesion requirements for coating applications:
 - a. What is a sufficient level of adhesion strength?
 - b. Avoid over-specifying adhesion requirements to the detriment of other product requirements.
 - c. Problem of long-term environmental degradation.

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

Level: Technical overview

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

Duration: 1 day

Registration fee: \$575 (Includes a complete set of course notes and a copy of "Adhesion Measurement of Films and Coatings", Ed. K.L. Mittal, VSP (1995))

How You Will Benefit From This Course:

- ▶ Understand advantages and disadvantages of a range of adhesion measurement techniques.
- ▶ Learn optimal methods for setting adhesion strength requirements for coating applications.
- ▶ Learn how to select the best measurement technique for a given application.

SYMPOSIUM RESPONSE FORM

If you would like to present a paper at any of the symposia mentioned above or simply attend, mail in the following response form

I would like to:

- | | |
|---|--|
| <input type="checkbox"/> present paper/ | <input type="checkbox"/> attend the INTERNATIONAL SYMPOSIUM ON POLYMER SURFACE CHARACTERIZATION; October 9-11, 2000 |
| <input type="checkbox"/> present paper/ | <input type="checkbox"/> attend the INTERNATIONAL SYMPOSIUM ON POLYMERS IN MICROELECTRONICS; October 11-13, 2000 |
| <input type="checkbox"/> present paper/ | <input type="checkbox"/> attend the INTERNATIONAL SYMPOSIUM ON ADHESIVES; November 27-29, 2000 |
| <input type="checkbox"/> present paper/ | <input type="checkbox"/> attend the INTERNATIONAL SYMPOSIUM ON INTERFACES IN POLYMER COMPOSITES; Nov. 30 - Dec. 1, 2000 |
| <input type="checkbox"/> present paper/ | <input type="checkbox"/> attend the THIRD INTERNATIONAL SYMPOSIUM ON POLYMER SURFACE MODIFICATION; May 21-23, 2001 |
| <input type="checkbox"/> present paper/ | <input type="checkbox"/> attend the INTERNATIONAL SYMPOSIUM ON SURFACE CONTAMINATION AND CLEANING; May 24-25, 2001 |
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| <input type="checkbox"/> present paper/ | <input type="checkbox"/> attend the THIRD INTERNATIONAL SYMPOSIUM ON SILANES; June 18-20, 2001 |
| <input type="checkbox"/> present paper/ | <input type="checkbox"/> attend the SECOND INTERNATIONAL SYMPOSIUM ON ADHESION ASPECTS OF THIN FILMS; November 5-7, 2001 |
| <input type="checkbox"/> present paper/ | <input type="checkbox"/> attend the THIRD INTERNATIONAL SYMPOSIUM ON ADHESION MEASUREMENT; November 7-9, 2001 |
| <input type="checkbox"/> present paper/ | <input type="checkbox"/> attend the SECOND INTERNATIONAL SYMPOSIUM ON POLYIMIDES; December 3-5, 2001 |
| <input type="checkbox"/> present paper/ | <input type="checkbox"/> attend the EIGHTH INTERNATIONAL SYMPOSIUM ON METALLIZED PLASTICS; December 6-7, 2001 |

I PLAN TO ATTEND SHORT COURSE ON ADHESION MEASUREMENT TECHNIQUES

MAIL THIS FORM TO:

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 Conference Chairman
 3 Hammer Drive
 Hopewell Junction, NY 12533

OR RESPOND BY:

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