



# Atmospheric Pressure Plasma For Surface Modification

**Srichand Hinduja, Kuang-Chao Fan**



## **Atmospheric Pressure Plasma For Surface Modification:**

**Atmospheric Pressure Plasma Treatment of Polymers** Michael Thomas, K. L. Mittal, 2013-06-19 An indispensable volume detailing the current and potential applications of atmospheric pressure plasma treatment by experts practicing in fields around the world. Polymers are used in a wide variety of industries to fabricate legions of products because of their many desirable traits. However, polymers in general and polyolefins in particular are innately not very adhesionable because of the absence of polar or reactive groups on their surfaces and concomitant low surface energy. Surface treatment of polymers however is essential to impart reactive chemical groups on their surfaces to enhance their adhesion characteristic. Proper surface treatment can endow polymers with improved adhesion without affecting the bulk properties. A plethora of techniques ranging from wet to dry, simple to sophisticated, vacuum to non vacuum for polymer surface modification have been documented in the literature but the Atmospheric Pressure Plasma (APP) treatment has attracted much attention because it offers many advantages vis-à-vis other techniques, namely uniform treatment, continuous operation, no need for vacuum, simplicity, low cost, no environmental or disposal concern, and applicability to large area samples. Although the emphasis in this book is on the utility of APP treatment for enhancement of polymer adhesion, APP is also applicable and effective to modulate many other surface properties of polymers: superhydrophilicity, superhydrophobicity, anti-fouling, anti-fogging, anti-icing, cell adhesion, biocompatibility, tribological behavior, etc. The key features of Atmospheric Pressure Plasma Treatment of Polymers: Address design and functions of various types of reactors; Bring out current and potential applications of APP treatment; Represent the cumulative wisdom of many key academic and industry researchers actively engaged in this key and enabling technology.

**Atmospheric Pressure Plasma for Surface Modification** Rory A. Wolf, 2012-11-08 This book's focus and intent is to impart an understanding of the practical application of atmospheric plasma for the advancement of a wide range of current and emerging technologies. The primary key feature of this book is the introduction of over thirteen years of practical experimental evidence of successful surface modifications by atmospheric plasma methods. It offers a handbook-based approach for leveraging and optimizing atmospheric plasma technologies which are currently in commercial use. It also offers a complete treatment of both basic plasma physics and industrial plasma processing with the intention of becoming a primary reference for students and professionals. The reader will learn the mechanisms which control and operate atmospheric plasma technologies and how these technologies can be leveraged to develop in-line continuous processing of a wide variety of substrates. Readers will gain an understanding of specific surface modification effects by atmospheric plasmas and how to best characterize those modifications to optimize surface cleaning and functionalization for adhesion promotion. The book also features a series of chapters written to address practical surface modification effects of atmospheric plasmas within specific application markets and a commercially focused assessment of those effects.

**Polymer Surface Modification** K. L. Mittal, 2000-09-28 This book chronicles the proceedings of the Second

International Symposium on Polymer Surface Modification Relevance to Adhesion held Newark New Jersey May 24 26 1999  
Polymeric materials are intrinsically not very adhesionable and this necessitates their surface treatment to enhance their adhesion characteristics to other materials Since the first symposium on this topic held in 1993 there has been a tremendous  
R Part 2 Other Miscellaneous Surface Modification Techniques and Part 3 General Papers The topics covered include plasma surface modification of a variety of polymers using various plasma gases atmospheric plasma system surface functionalization ultrahydrophobic polymeric surfaces metallization of plasma treated polymers surface modification of polymers via molecular design for adhesion promotion wet chemical methods for polymer surface modification laser surface modification of various polymers UV ozone treatment surface and interface studies of treated polymer surfaces by an array of techniques bioadhesion of polymeric biomaterials to tissue polymer fiber systems and plasma deposited coatings

**Proceedings of the 35th International MATADOR Conference** Srichand Hinduja, Kuang-Chao Fan, 2007-06-30

Presented here are 88 refereed papers given at the 35th MATADOR Conference held at the National University of Taiwan in Taipei Taiwan in July 2007 The MATADOR series of conferences covers the topics of Manufacturing Automation and Systems Technology Applications Design Organisation and Management and Research The proceedings of this conference contains original papers contributed by researchers from many countries on different continents The papers cover the principles techniques and applications associated with manufacturing processes technology system design and integration and computer applications and management The papers in this volume reflect the importance of manufacturing in international wealth creation the emerging fields of micro and nano manufacture the increasing trend towards the fabrication of parts using additive processes the growing demand for precision engineering and part inspection techniques measurement techniques and equipment *Surface Modification and Metal Printing Using Atmospheric Pressure Plasma* M. Emre Sener, 2021 Nonthermal Plasma Surface Modification of Materials Masaaki Okubo, 2023-10-31 This book describes the fundamentals and applicability of the atmospheric pressure non thermal plasma surface modification of materials Non thermal plasma modification is an effective procedure for chemical activation In this book the principles of non thermal plasma surface modification and its application to various machine parts are described By reading this book technologists from a variety of fields can learn about plasma generation and surface treatment technology which will assist them in performing advanced procedures This book also explains the basics of atmospheric pressure plasma and the principle of plasma treatment in an easy to understand manner and also provides examples of the application of atmospheric pressure plasma surface modification technologies to plastics glass polymers and metals After reading this book readers can get the knowledge that researchers need to apply the methodology to meet their own research goals The book is self contained in the sense that it spans the divide between the fundamentals and more advanced content regarding applications Many engineers and graduate students working in this field get many helps Use of Atmospheric-Pressure Plasma Jet for Polymer Surface

Modification ,2017 Atmospheric pressure plasma jets APPJs are playing an increasingly important role in materials processing procedures Plasma treatment is a useful tool to modify surface properties of materials especially polymers Plasma reacts with polymer surfaces in numerous ways thus the type of process gas and plasma conditions must be explored for chosen substrates and materials to maximize desired properties This report discusses plasma treatments and looks further into atmospheric pressure plasma jets and the effects of gases and plasma conditions Following the short literature review a general overview of the future work and research at Los Alamos National Laboratory LANL is discussed **Influence of**

**Low Atmospheric Pressure Plasma on Surface Modification of Phenolic Bonded Aspen Fiberboard** Vladimir Totolin,2006 Polymer Surface Modification to Enhance Adhesion K. L. Mittal,Anil N. Netravali,2024-04-02 POLYMER SURFACE MODIFICATION TO ENHANCE ADHESION This unique comprehensive and groundbreaking book is the first on this important subject Polymer Surface Modification to Enhance Adhesion comprises 13 chapters and is divided into two parts Part 1 Energetic Treatments and Part 2 Chemical Treatments Topics covered include atmospheric pressure plasma treatment of polymers to enhance adhesion corona treatment of polymer surfaces to enhance adhesion flame surface treatment of polymers to enhance adhesion vacuum UV photo oxidation of polymer surfaces to enhance adhesion optimization of adhesion of polymers using photochemical surface modification UV Ozone surface treatment of polymers to enhance adhesion adhesion enhancement of polymer surfaces by ion beam treatment polymer surface modification by charged particles laser surface modification of polymeric materials competition in adhesion between polysort and monosort functionalized polyolefinic surfaces amine terminated dendritic materials for polymer surface modification arginine glycine aspartic acid RGD modification of polymer surfaces and adhesion promoters for polymer surfaces Audience The book will be of great interest to polymer scientists surface scientists adhesionists materials scientists plastics engineers and to those involved in adhesive bonding packaging printing painting metallization biological adhesion biomedical devices and polymer composites **Polymer Surface Modification: Relevance to Adhesion, Volume 3** Kash L. Mittal,2004-08-26 This book documents the proceedings of the Fourth International Symposium on Polymer Surface Modification Relevance to Adhesion held under the auspices of MST Conferences LLC in Orlando FL June 9 11 2003 Polymers are used for a variety of purposes in a host of technological applications and even a cursory look at the literature will evince tha

*Polymer Surface Modification: Relevance to Adhesion, Volume 4* Kash L. Mittal,2007-05-11 This book documents the proceedings of the Fifth International Symposium on this topic held in Toronto The book is divided into two parts Part 1 Surface Modification Techniques Part 2 Adhesion Improvement to Polymer Surfaces Various ways to modify a host of polymer surfaces for a variety of purposes are covered in this book with emphasis on **Plasma Technology for Deposition and Surface Modification** Mohammad Mokbul Hossain,2009 Plasma processing is a high technology discipline in tailoring surface properties and in obtaining functional polymers of advanced materials without changing the material s bulk Comparing with

solid polymeric materials special care should be taken for surface activation of textiles due to their complex geometries It was found that modification is strongly influenced by both plasma parameters and fabric structure As compared to air CO<sub>2</sub> and water vapor Ar O<sub>2</sub> and He O<sub>2</sub> mixtures were found to be very effective for surface hydrophilization of polyester textiles due to the long lasting free radical lifetimes The modified surfaces were not stable for a long time due to restructuring of the polar functional groups Therefore plasma coatings containing functional groups are required in order to obtain a permanent surface modification Permanent nanoporous coatings were deposited in order to obtain functional surfaces which contain accessible functionalities within the entire coating volume This novel approach is essentially based on a fine control of simultaneous deposition and etching processes during plasma co polymerization of ammonia with hydrocarbons A nanoporous structure with a large specific surface area was achieved that contained functional groups inside the coating volume which were accessible to e g dye molecules thus facilitating substrate independent dyeing A permanent hydrophilic modification of material surfaces was obtained by introducing nitrogen polar functionalities depending on the NH<sub>3</sub> to hydrocarbon ratio which is mostly due to a replacement of carbon in a C H N films This novel combination of polar groups with a suitable texturing realized within crosslinked aC H N coatings proved to be an efficient method providing a long term mechanical stability of superhydrophilic coatings Moreover plasma coated material surfaces contain huge numbers of functional groups which can chemically interact with matrix materials and hence yield strong covalent bond between fiber and matrix The coatings show a large surface area which enhances the contact area and surface texturing and additionally promotes mechanical interlocking Thus the novel developed nanoporous coatings represent a platform for diverse multifunctional applications in the surface enhancement of advanced materials

**Surface Modification to Improve Properties of Materials** Miran Mozetič, 2019-04-16 This book contains selected contributions on surface modification to improve the properties of solid materials The surface properties are tailored either by functionalization etching or deposition of a thin coating Functionalization is achieved by a brief treatment with non equilibrium gaseous plasma containing suitable radicals that interact chemically with the material surface and thus enable the formation of rather stable functional groups Etching is performed in order to modify the surface morphology The etching parameters are selected in such a way that a rich morphology of the surfaces is achieved spontaneously on the sub micrometer scale without using masks The combination of adequate surface morphology and functionalization of materials leads to superior surface properties which are particularly beneficial for the desired response upon incubation with biological matter Alternatively the materials are coated with a suitable thin film that is useful in various applications from food to aerospace industries

*Surface Modification by Atmospheric Pressure Plasma for Improved Bonding* Thomas Scott Williams, 2013 An atmospheric pressure plasma source operating at temperatures below 150 °C and fed with 10.30 volume% oxygen in helium was used to activate the surfaces of the native oxide on silicon carbon fiber reinforced epoxy composite stainless steel type 410 and aluminum alloy 2024 Helium

and oxygen were passed through the plasma source whereby ionization occurred and  $10^{16} \text{ cm}^{-3}$  oxygen atoms  $10^{15} \text{ cm}^{-3}$  ozone molecules and  $10^{16} \text{ cm}^{-3}$  metastable oxygen molecules  $O(21\Delta_g)$  were generated. The plasma afterglow was directed onto the substrate material located 4 mm downstream. Surface properties of the plasma treated materials have been investigated using water contact angle (WCA), atomic force microscopy (AFM), infrared spectroscopy (IR) and x-ray photoelectron spectroscopy (XPS). The work presented herein establishes atmospheric pressure plasma as a surface preparation technique that is well suited for surface activation and enhanced adhesive bond strength in a variety of materials. Atmospheric plasma activation presents an environmentally friendly alternative to wet chemical and abrasive methods of surface preparation. Attenuated total internal reflection infrared spectroscopy was used to study the aging mechanism of the native oxide on silicon. During storage at ambient conditions, the water contact angle of a clean surface increased from **Plasma**

**Modification of Polyolefins** N. S. Baneesh, P. S. Sari, Tatana Vackova, Sabu Thomas, 2021-11-22 This book addresses plasma modification of polyolefin surfaces. It comprises 21 chapters divided into three major sections. The first section covers the different techniques used for plasma modification of polyolefin surfaces and the effects of various gases as a surrounding medium while the second provides a detailed analysis of the physics and chemistry of plasma modification and discusses various innovative characterization techniques as well as ageing of the modified surface. It focuses on the analysis of changes in polymers surface chemistry using various spectroscopic techniques and of changes in their surface morphology after plasma treatment using optical microscopy, electron microscopy and atomic force microscopy. In addition, it provides detailed information on the characterization of modified polymer surfaces. The book's third and last section covers a range of applications of plasma modified polyolefin surfaces varying from the packaging industry to the biomedical field and shares valuable insights on the lifecycle analysis of plasma modification and modified surfaces **Advances in Plasma Treatment**

**of Textile Surfaces** Shahid Ul Islam, Aminoddin Haji, 2024-01-24 *Advances in Plasma Treatment of Textile Surfaces* offers a detailed overview on the use of plasma in natural and synthetic textiles and also explores recent applications in technical textiles including composites, ballistic performance, functionalization and textile wastewater treatment. This promising technology can alter the surface properties of textiles without having a significant effect on their bulk properties, leading to potential improvements to the scouring, de-sizing, dyeing, finishing, printing and laminating processes among others. Drawing on an international team of contributors from industry as well as academia, this important book is bringing these innovative sustainable plasma treatments to textile and polymer scientists everywhere working in the field of textile functionalization. Provides detailed technical descriptions of cutting edge applications of plasma in nanotechnology, biotechnology and other fields. Describes the different kinds of plasma treatment equipment and compares their use for different effects. Starts with overviews of basic information such as how to determine surface properties **Surface Modification of Textiles** Q

Wei, 2009-08-26 The surface of textiles offers an important platform for functional modifications in order to meet special

requirements for a variety of applications The surface modification of textiles may be achieved by various techniques ranging from traditional solution treatment to biological approaches This book reviews fundamental issues relating to textile surfaces and their characterisation and explores the exciting opportunities for surface modification of a range of different textiles Introductory chapters review some important surface modification techniques employed for improved functional behaviour of textiles and the various surface characterisation methods available Further chapters examine the different types of surface modification suitable for textiles ranging from the use of plasma treatments and physical vapour deposition to the use of nanoparticles Concluding chapters discuss surface modification strategies for various applications of textiles Surface modification of textiles is a valuable resource for chemists surface scientists textile technologists fibre scientists textile engineers and textile students Reviews fundamental issues relating to textiles surfaces and their characterisation Examines various types of surface modification suitable for textiles including plasma treatments and nanoparticles Discusses surface modification strategies for textile applications such as expansion into technical textile applications *Surface Modification of Paper on a Continuous Atmospheric-pressure-plasma System* Luis Emilio Cruz-Barba,2003 **Progress in Adhesion and Adhesives, Volume 7** K. L. Mittal,2023-12-27 The current book contains eight commissioned chapters and cover topics including stress distribution and design analysis of adhesively bonded tubular composite joints durability of structural adhesive joints mechanical surface treatment of adherends for adhesive bonding surface modification of polymer materials by excimer UV light corona discharge treatment of materials to enhance adhesion adhesion activation of aramid fibers dual cured hydrogels for bioadhesives and biomedical applications and non adhesive SLIPS like surfaces *Biodegradable Green Composites* Susheel Kalia,2016-02-29 This book comprehensively addresses surface modification of natural fibers to make them more effective cost efficient and environmentally friendly Topics include the elucidation of important aspects surrounding chemical and green approaches for the surface modification of natural fibers the use of recycled waste properties of biodegradable polyesters methods such as electrospinning and applications of hybrid composite materials

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