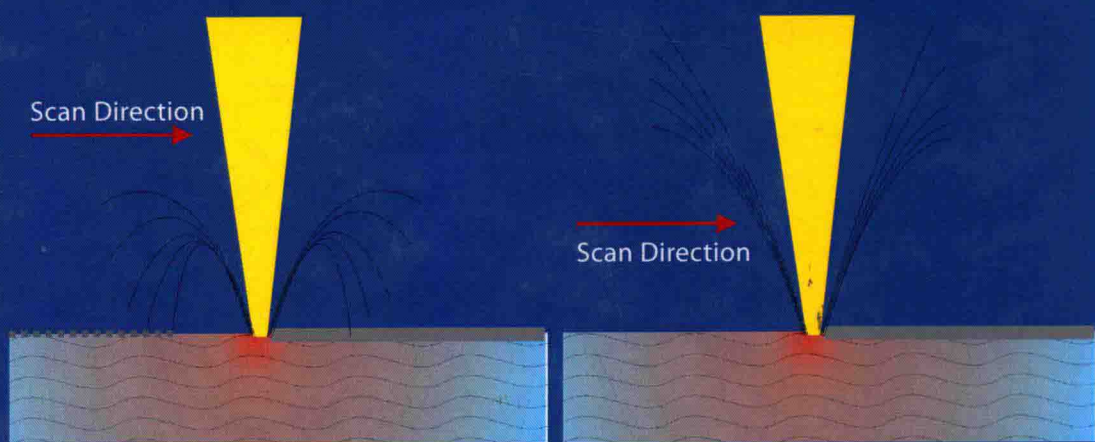


ADHESION AND ADHESIVES: FUNDAMENTAL AND APPLIED ASPECTS

# Laser Surface Modification and Adhesion



Edited by K.L. Mittal and Thomas Bahners

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Edited by

**K.L. Mittal and Thomas Bahners**



**WILEY**

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# Laser Surface Modification and Adhesion

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**Adhesion and Adhesives: Fundamental and Applied Aspects**

The topics to be covered include, but not limited to, basic and theoretical aspects of adhesion; modeling of adhesion phenomena; mechanisms of adhesion; surface and interfacial analysis and characterization; unraveling of events at interfaces; characterization of interphases; adhesion of thin films and coatings; adhesion aspects in reinforced composites; formation, characterization and durability of adhesive joints; surface preparation methods; polymer surface modification; biological adhesion; particle adhesion; adhesion of metallized plastics; adhesion of diamond-like films; adhesion promoters; contact angle, wettability and adhesion; superhydrophobicity and superhydrophilicity. With regards to adhesives, the Series will include, but not limited to, green adhesives; novel and high-performance adhesives; and medical adhesive applications.

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## Preface

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Surface modification (also known as treatment, pre-treatment and activation) of different materials (metals, ceramics, polymers, composites,) is *sine qua non* to impart surface characteristics for their applications for a legion of purposes. The beauty of surface modification is that it provides the requisite surface properties without tempering with the bulk, thus retaining the desirable attributes of bulk materials.

By using apropos surface modification process one can attain a host of surface properties (e.g. adhesion, wetting, superhydrophilicity, superhydrophobicity, omniphobicity, anti-fouling, biocompatibility, to name just a few). For example, adhesive bonding is commonly used to bond similar or dissimilar materials or components to make integral parts as it offers certain advantages vis-à-vis mechanical methods of fastening or mating. However, for adhesive bonding purpose proper surface chemistry (functional groups) and surface topography (morphology) are a desideratum. Laser surface modification of a variety of substrate materials has been shown to be effective for such purpose. Particularly, polymers are innately inert (chemically speaking) and thus it becomes imperative to activate/modify polymeric materials to generate appropriate surface characteristics, depending on the application. A plethora of techniques (ranging from wet to dry, vacuum to non-vacuum, simple to sophisticated, inexpensive to sumptuous) exist for surface modification of a variety of polymers, but the laser surface treatment provides a “cool” and “green” technique. Depending on the laser energy, there can be chemical changes (generation of functional groups) or ablation. Even a cursory look at the literature will evince that there is a flurry of research activity in laser surface modification and all signals indicate that this tempo of research and interest in laser surface treatment will continue unabated. More recently, there has been interest in laser surface modification of various reinforcements (fillers, fibers, nanotubes and graphene).

Now coming to this book (containing 10 chapters) it is divided into two parts: Part 1: Laser Surface Treatment/Modification to Enhance Adhesion, and Part 2: Other Effects/Implications of Laser Surface Treatment. The topics covered include: Nd:YAG laser surface treatment of various materials to enhance adhesion; effects of excimer laser treatment on self-adhesion strength of some commodity and engineering plastics; laser surface pretreatment of carbon fiber-reinforced plastics for adhesive bonding; laser surface modification of fibers for improving fiber-resin interfacial interactions in composites; effect of laser surface modification on the adhesion of dental restorative materials; fundamentals of laser-polymer interactions and their relevance to polymer metallization; laser patterning of carbon/polymer bipolar plates for fuel cell applications; parameters governing the wettability characteristics of laser modified engineering materials; laser surface engineering of polymeric materials and the effects on wettability characteristics; and water adhesion to laser-treated surfaces.

This book represents the cumulative wisdom and contribution of many internationally renowned subject matter experts in the domain of utilization of lasers not only to enhance adhesion but also to achieve other surface characteristics for a host of applications. As new and more effective laser sources become available, new application vistas will emerge.

The book containing a wealth of information on fundamental and applied aspects of laser surface modification provides an easily accessible unified and comprehensive source. To our knowledge this is the first book on such a technologically important topic. With time, this emerging technique for surface modification will mature and will become a part of the surface treatment arsenal.

The book should be of interest to researchers in academia and R&D personnel in a host of industries (e.g., microelectronics, automotive, packaging, adhesive bonding, printing, metallized plastics, aerospace, dentistry, textiles, biomedical) where the success depends on suitable surface modification. Essentially, anyone interested or involved in surface modification (centrally or peripherally) should find this book useful. In our opinion, this concise treatise should serve as a primer for the neophytes and a digest of recent developments for more seasoned researchers. Also we hope this book will serve as a fountainhead for new ideas and novel approaches in the arena of laser surface modification.

Now it is our pleasure to thank those who made this book possible. First and foremost, we are beholden to the authors for their sustained interest, enthusiasm and cooperation and for sharing their knowledge (in the form of chapters) without which this book could not be materialized. Also

we very much appreciate the unwavering interest and support of Martin Scrivener (Scrivener Publishing) in this book project and for giving this book a body form.

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