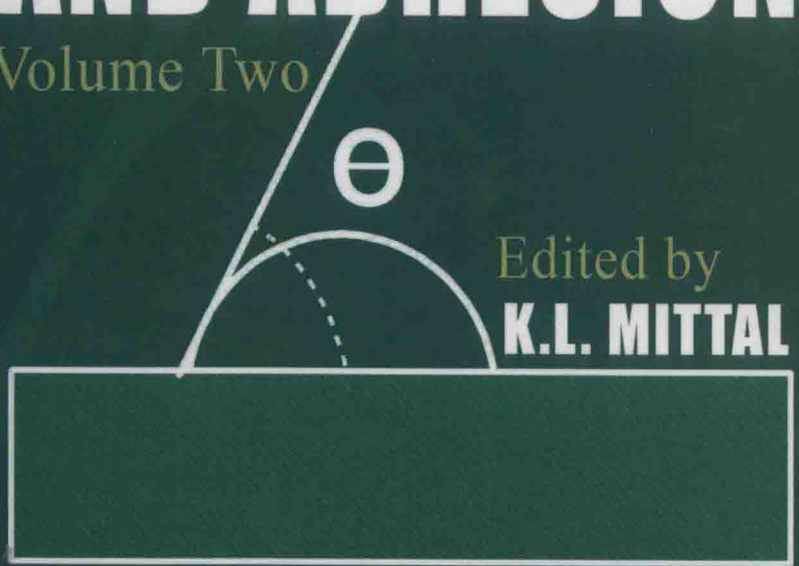
Adhesion and Adhesives: Fundamental and Applied Aspects

ADVANCES IN CONTACT ANGLE, WETTABILITY AND ADHESION

Volume Two



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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

The express purpose of this book series, *Advances in Contact Angle, Wettability and Adhesion,* is to provide a continuous state-of-the-art critical look at the current knowledge and latest developments in the arena of contact angle, wettability and adhesion.

Some historical facts related to the primordial study and evolution of contact angles and wetting phenomena were described in the Preface to Volume 1. Here I would like to supplement that information by mentioning some other significant milestones in the same vein. First, it is interesting to note that the titans of science like Einstein, Schrödinger and Bohr—all Nobel Laureates—evinced keen interest in capillarity (related to contact angle) and devoted part of their research to this topic. Next, the discovery of electrocapillarity, which in essence signifies manipulation/modulation of wettability (contact angle) by application of electric field, is attributed to the seminal and trailblazing work of Gabriel Lippmann (Nobel Laureate for Physics 1908) as part of his Ph.D. thesis. Electrowetting (EW) or modern electrowetting EWOD (electrowetting on dielectric) was developed from the phenomenon of electrocapillarity investigated in detail by Lippmann. So Gabriel Lippmann can aptly be called the father of electrowetting. Since the discovery of electrocapillarity, the ability to manipulate properties at the phase boundary by applied electric field has been vigorously pursued. The high tempo of research in EW stems from the fact that EWOD can be employed for a broad range of applications involving manipulations of liquids and requiring miniaturization of system size and improving its effectiveness. Lab-on-a-chip is a prime example of the application of EWOD. Lab-on-a-chip has been used in biomedical and analytical devices. Next, the work of the College de France, Paris, a world-renowned research school headed by Pierre-Gilles de Gennes (Nobel Laureate in Physics 1991), deserves special mention for its tremendous contribution towards understanding and explaining wetting phenomena (dynamics of wetting). Therefore, one can see that five Nobel Laureates have contributed to and brought glamour to the fascinating field of contact angles and wetting phenomena.

These days there is an overwhelming interest in biomimetics. According to Wikipedia, biomimetics or biomimicry is the imitation of the models, systems and elements of Nature for the purpose of solving complex human problems. Nature is a great teacher and the old adage, "Nature does not waste time in making frivolous or useless things," is dead true; in this context, the lotus leaf is a classic paradigm. Even a cursory look at the literature will evince that currently there is a proliferation of research activity in all facets/ramifications of contact angles and wetting phenomena, and all signals indicate that this accelerated pace will be maintained.

The 17 research and review chapters comprising this book are divided into three parts – Part 1: Fundamental and General Aspects; Part 2: Wettability Modification; and Part 3: Surface Free Energy and Adhesion. The topics covered include: wetting of solid walls and spontaneous capillary flow; "ordered water monolayer that does not completely wet water" at room temperaure; Cheerios effect and its control by contact angle modulation; mathematical analysis of contact angle hysteresis; computational analysis of wetting and application to self-cleaning mechanisms; bubble adhesion to superhydrophilic surfaces; relationship between the roughness and oleophilicity of surfaces; liquid repellent amorphous carbon nanoparticle networks; mechanical durability of liquid repellent surfaces; superhydrophobic and superoleophobic biobased materials; laser ablation to render stainless steel superhydrophobic; RF plasma treatment of Neptune grass (*Posidonia oceanica*) to achieve superhydrophilic surfaces; combined photochemical and laser surface modifications to achieve liquid repellent textile surfaces; modification of paper/cellulose to control liquid wetting and adhesion; surface free energy of superhydrophobic materials; role of surface free energy in pharmaceutical tablet strength; and why test inks cannot tell the whole truth about surface free energy of solids.

As for this volume, it is essentially based on the written accounts of papers presented at the Ninth International Symposium on Contact Angle, Wettability and Adhesion held at Lehigh University, Bethlehem, PA, on June 16–18, 2014, under the auspices of MST Conferences. It should be recorded for posterity that all manuscripts submitted for this book were rigorously peer reviewed, suitably revised (some twice or thrice) and properly edited before inclusion in this book. As a matter of fact, some manuscripts are not included as they did not pass muster. So this book is not a mere collection of unreviewed and unedited papers, rather it represents articles which have passed rigorous peer scrutiny. Concomitantly, these articles are of archival value and their standard is as high as any journal or even higher than many journals.

It is quite manifest from the topics covered that the 17 chapters written by top-notch researchers which comprise this book address many aspects and ramifications of contact angles and wettability. The book provides a commentary on the current research being actively pursued in this domain and summarizes the research results of many active researchers in this field. Yours truly hopes that anyone wishing to stay abreast of the latest developments and prospects within the purview of contact angle, wettability and adhesion will find this book of great interest and value. In essence, Volume 2 supplements the information consolidated in its predecessor, Volume 1. In closing, I hope the information presented in this volume will spur further research and will serve as the provenance for new ideas. As we learn more about the wettability behavior of surfaces, new and exciting application vistas will emerge. All signals indicate that the high tempo of research in this field will continue unabated.

Now it is my pleasant duty to thank all those who contributed in many different ways in bringing this book to fruition. First and foremost, I am beholden to the authors for their enthusiasm, cooperation and contribution, without which this book would not have seen the light of day. Second, I would like to profusely thank the reviewers for their time and efforts in providing invaluable comments and suggestions which definitely improved the quality of articles included in this book. The comments from peers are a prerequisite for maintaining the highest standards of any publication. Last, but not least, my sincere appreciation goes to Martin Scrivener, publisher, for his unwavering support of this project and for giving this book a body form.

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