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Surface Science Techniques

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To Luca and Sarah

Preface

The very first idea of a book on Surface Science techniques came at the 26th European Conference on Surface Science (2009, Parma, Italy) during the session on new experimental techniques. After this first burgeon, it took several months of 2010 for a complete plan to appear and be shaped to a definite form with a list of authors and a table of contents. The task was not easy since the first part of the editorial work was to decide the type of scope: a collection of chapters in which important results are described or a book more oriented towards the description of the experimental aspects of techniques.

Since the experience and the inclination of the Editors are on experiments and the construction of instrumentation we were naturally keen on the latter approach. Moreover we think that for many readers, who are not experts in a particular field, it is important to understand what is going on behind important results and, in a normal scientific article, the experimental details are sometimes not so explicit. The need for a more in depth knowledge of techniques is especially important for students involved in experimental research, as a support to help them understanding the literature and planning successful experiments with the right techniques. In fact, this is our greatest hope: If this book can assist the readers in finding the right technique for answering their scientific questions, then it has certainly justified its existence.

After the choice of the approach, the second step was the choice of the techniques which should appear as representative for the study of surfaces. The number of Surface Science techniques is huge and, for a single book, a selection had to be made.

The concept of surface involves both macroscopic as well as microscopic issues therefore, although microscopic techniques form the main core of the book, a few macroscopic techniques have been included. For the microscopic techniques, penetration depth is a particular crucial issue. Some techniques are strictly not penetrating while others probe several atomic/molecular layers. We decided to include also very penetrating techniques because the study of the interfaces is an important topic which cannot be neglected in Surface Science. The environment of the surface is another issue of crucial importance. Surfaces in ultra high vacuum can be kept clean for long periods of time and this is the traditional environment for

Surface Science techniques. However, industrial processes require high pressures, electrochemical investigations are performed in a liquid solution and surfaces of biological interest generally need a moist environment. For these reasons, techniques that can be applied in these realistic conditions are included in the book and we have decided to split the atomic force microscopy chapter in two chapters dealing with ultra high vacuum and liquid environment cases, respectively. Finally, due to the obvious relationship between Surface Science and Nanotechnology, topics related to nanostructuring of surfaces are also presented.

We believe that our choice of techniques is broad enough to allow the reader to understand how a study of surface (and interface) properties can be performed and how the various experimental problems might be tackled. In these choices we got very good support from several colleagues who suggested improvements in the schemes of the chapters. Surface Science is an interdisciplinary field and only a collaborative work can give rise to successful result: the same applies to this book.

The chapters are organized in parts: macroscopic techniques (contact angle and single-crystal adsorption calorimetry), microscopic techniques (optical and X-ray techniques for photons, charged (electrons and ions) and neutral particle (atoms, molecules and neutrons) techniques), and scanning probe microscopies.

Finally, we would like to thank all the participants to this project: first of all the authors who have accepted our invitation with enthusiasm and did most of the real work, then the following colleagues for their helpful suggestions: Giacinto Scoles (Udine, Italy and Princeton U.,USA), William Allison (Cambridge U., UK), Jochen Stahn (ETH Zurich and Paul Scherrer Institut, CH), Peter O'Toole (U. of York, UK), Kim Lefmann (Niels Bohr Institute, Copenhagen U., DK), Salvatore Iannotta (CNR-IMEM, Italy), Gang-yu Liu (U. of California Davis, USA), Neil Curson (U. of Nottingham, UK), Larry Scipioni (Carl Zeiss SMT), Miquel Salmeron (Lawrence Berkeley National Lab, USA), Enrico Gnecco (IMDEA Nanociencia, Madrid, Spain), Giorgio Benedek (U. of Milano-Bicocca, Italy), Charles T. Campbell (U. of Washington, USA) and David C. Joy (U. of Tennessee, USA), and last but not least, a thanks to Dr. Claus Ascheron and the staff of Springer who provided the necessary support for the accomplishment of the book.

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Part VI Scanning Probe Techniques

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