

Preface to the Second Edition

A number of new experimental innovations have been added in over 50 new chapters. I thank each of the innovators for their contributions which are acknowledged in the text. I very much appreciated the graphical work of Dr. Ana Stevanovic who skillfully converted hand drawings to computer graphics. I also deeply appreciate the assistance of Dr. Zhen Zhang in assembling the new and former material to produce a well-organized second edition. And finally, I wish to thank Dr. Winfried Heichler and his son Jan Heichler for important high-resolution optical scanning of the first edition, allowing its fusion with new material in the second edition. I also thank the Department of Chemistry at the University of Virginia for financial support of the graphics effort. And finally, as in the first edition, I thank my loving and caring wife, Kerin Yates, for her continued support and constructive criticism of the new book.

Virginia

John T. Yates Jr.

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The modern era of surface science, developed in the last 30 years, features hundreds of new physical and chemical measurement methods such as low-energy electron diffraction and Auger electron spectroscopy, which form a vital foundation for the field. These measurement methods constitute the basis for a number of books used by beginning students as their introduction to experimental research.

This book is not about this particular experimental core of the field. Instead, it is about those practical laboratory methods used throughout the field, but seldom communicated coherently in writing and drawings to beginning students. These practical methods of design, construction, and measurement also form their own foundation for making possible significant research. They constitute a gold mine of clever ideas and “tricks of the trade” about how to use basic materials and components effectively for research and measurement in surface science. Approximately 250 practical methods are described in the book in enough detail that one could design a new experimental device from the book alone.

This book will be useful to beginning research workers in surface science as well as to those who work with similar methods in fields such as semiconductor technology, materials science, and physical electronics.

The contents of the book have been selected from unpublished information supplied by more than 100 workers in the field as well as from the literature, dating back to the mid-1960s. I have attempted to communicate the core ideas from published and unpublished accounts of research in easy-to-comprehend pictorial form, believing that pictures are the most effective mode for communication of information of this type. Thus, the reader can learn much just by looking at the pictures. The text associated with each drawing gives more details. In many cases, the text and its citations indicate the originators and subsequent contributors to the innovation, but in other cases the origin of the key ideas is unknown, making accurate historical citations impossible.

There are some topics that have not been addressed in the book, primarily because they are currently highly specialized and fast-moving activities that are best learned by advanced research students who have previously mastered some of the topics covered in this book. Untreated topics include many details of the scanning

tunneling microscope (STM), complex molecular beam techniques, and complex laser-based measurements.

Updated information on United States and international suppliers of materials and components used in surface science research is featured at the end of the book. Here the reader will find a guide to product sources as well as addresses and other communications information for all companies mentioned in the text footnotes as well as many other company listings. I thank Dr. Jun Yoshinobu and Dr. Joachim Ahner for help with these compilations.

I very much appreciate the involvement of many friends and colleagues who have contributed to this book by sending me accounts of their innovative methods. This includes many of my own students and postdoctoral who have developed some of the experimental methods described here. I also thank the publishers of the *Journal of Vacuum Science and Technology* for permission to use many published contributions dating back to 1964. These were organized for me by Professor Michael Bozack and Mr. Kenneth W. Bryant at Auburn University, to whom I am greatly indebted, and were invaluable in writing a portion of this book. I thank Dr. Fred Dylla and Mrs. Maria Taylor for their encouragement during work with AIP and with Springer-Verlag as the book progressed. Mrs. Marge Augenstein and Mrs. Mary Beth Merenick supplied accurate assistance in organizing the collection and verification of information for the book at the University of Pittsburgh, and in checking the accuracy of the citations. Ms. Hana Novak took my hand-drawn mechanical drawings and skillfully converted them to computer graphics. The book would not have been produced without the financial assistance of the Alexander von Humboldt Stiftung, which made possible my stay in the Department of Physics, Philipps University, Marburg, Germany. I am indebted also to the University of Pittsburgh for a coincident sabbatical leave to write the book. I wish to thank my many German friends for their hospitality, particularly Dr. Heinz J. Jaensch and Professor Dieter Fick for their friendship during my seven months in Marburg. I also thank my parents, Mr. and Mrs. J. Thomas Yates, Sr., for their hospitality in Hagerstown, Maryland, during the completion of the book. And finally, and most importantly, I thank my wife, Kerin, for all of her support. Without her understanding and constructive criticism, writing and illustrating the book would have been impossible.

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