Preface

The aim of this book is mainly to help the practical analyst in his daily work on a rather basic level. Furthermore, it should serve as a guide for students working for their master's or Ph.D. thesis in materials science by teaching them about capabilities and limitations of applied surface analysis using AES and XPS in their special field. The reader may ask: why another book on a topic that is already covered by excellent books such as Briggs and Seah (1990) [1], Briggs and Grant [2], and Watts and Wolstenhome [3]. The answer is manifold: Book [1] is still excellent but outdated in some special although important aspects of quantitative analysis or depth profiling; book [2], thought as a replacement of [1] after 13 years, in many aspects is too much detailed and theoretically based for practical applications, a book aimed at the advanced spectroscopist. Book [3] is highly recommended as an introduction for the beginner but as such lacks the quantitative information and data needed for the practical researcher in daily work. In short, the author's intention is to provide a compendium that fulfills the gap between [2] and [3]. In addition, the above argument for [2] may hold here too, since at least a few topics were introduced only in recent years, such as the surface excitation parameter (SEP) or the backscattering correction factor (BCF). Furthermore, I adopt the point of view already mentioned by René Descartes in 1637 (p. 11 of Ref. [4]): "…there is often less perfection in works composed of several parts, and made by the hands of a variety of contributors, than in those one which only one person has worked on ….". After having established the surface and interface analysis group in the Max Planck Institute on Metals Research in Stuttgart, the author has worked more than 30 years in application of AES and XPS to Materials Science. This seems to be an advantage at first sight, but it bears an inevitable disadvantage: personally unique experience leaves everybody somehow biased about the importance and the treatment of specific topics. Therefore, the book appears like a homunculus picture in psychology, where the size of an organ is displayed according to the volume the brain needs for its operation. Thus, I have to apologize that the contents may appear somehow imbalanced to many colleagues. For example, sputter depth profiling is highly emphasized, as are the practical issues of quantification, signal-to-noise and detection limit, at the cost of

the more cursorily presented theoretical background. The book frequently refers to the original, pioneering work that is easier to understand and most often is best understood today. The intention is to build a bridge to the more recent research on the same topic where the full range of possibilities of modern instrumentation and new theory is revealed. I have always tried to follow the four basic rules of scientific research as postulated by René Descartes in his famous *Discourse on Method* [4]: (1) Do not believe anything that you did not think about thoroughly and with utmost scrutiny, (2) always try to decompose complex problems into smaller, less complex parts, (3) after having solved the partial problems, put them together again to solve the original task, and (4) always be as quantitative as possible. For me, rules (1) and (4) seem to be the bottom line of any scientific approach. Therefore I recommend that the reader applies these rules, in particular rule (1), to the book too, and I can only hope that the outcome is not unfavorable for the book. This mutual problem was addressed already by one of the first German physicists, Georg Christoph Lichtenberg (1742–1799), when he said: *Wenn ein Buch und ein Kopf zusammenstoßen und es klingt hohl, ist das allemal im Buch?*, which means: *If there is a collision of a book and a head and it sounds hollow, will this sound always be caused by the book?*

The ten chapters of the book are strongly cross-linked with each other. The reader is guided from the broader, introductory issues, such as historical background and basic principles (Chap. 1), to more special topics like instrumentation (Chap. 2) and qualitative analysis (Chap. 3), and to the most essential topics such as quantitative analysis (Chap. 4). Extending that issue to optimizing signal intensity (Chap. 5), which considers angular relations and roughness effects, the general role of signal-to-noise ratio in optimization of certainty and detection limit is outlined in Chap. 6. Being the focus of any surface (and thin film) analysis, quantitative compositional depth profiling (destructive and non-destructive) is presented Chap. 7. The following chapters are of more qualitative character but are nevertheless important for the analytical strategy. The latter topic is addressed in practical aspects of surface and interface analysis (Chap. 8), which contains many hints and tips for sample handling and for solving problems such as charging and beam damage effects. Some typical examples (Chap. 9) illustrate proper usage of the previous chapters (Chaps. 3–8). The final chapter, related surface analysis techniques (Chap. 10), gives an outlook to various methods which often are complementary to AES and XPS.

Thus, I like to encourage the reader to read the book critically but with open mind and optimism. My hopes were already expressed by Friedrich Nietzsche (1844–1900) in his book *Die froehliche Wissenschaft* (*The Joyful Science*):

> Wagt's mit meiner Kost ihr Esser
> Morgen schmeckt sie euch schon besser
> Und schon uebermorgen gut.

Approximately this means:

Be courageous, taste this book
Tomorrow you may like it better
And later you may think it's good.

Stuttgart Siegfried Hofmann

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