Preface

Over the last 20 years, I have been intensively involved in semiconductor process technology research, development, and manufacturing. Alongside my professional career, I have also enjoyed teaching semiconductor processing at Tamkang and Chinghwa universities as an adjunct professor. The contents of this book have largely evolved from the handouts that I prepared over the years for these courses. I also revised the course material for training junior engineers at various semiconductor companies. My experience indicates that it is relatively difficult for people who first embrace the semiconductor world to comprehend the essence of semiconductor processing technology. This is largely due to the fact that most people have a single engineering discipline in schools, while semiconductor processing is interdisciplinary in nature. It even takes a person with an engineering degree a few years before he or she can gain a good grasp of the overall semiconductor processing technology.

This book aims to provide readers with an easy-to-understand view of semiconductor industry, technology, and manufacturing. The first two chapters provide an overview of the industry. This includes an introduction to semiconductor processing and what the industry is focusing on. In addition, the integrated manufacturing flow, from raw material to device passivation, is explained, and each involved process module is defined. It also explains what ICs are and what they consist of. The following chapters further elaborate each individual process module technology. By and large, the sequence of the process module introduction follows typical manufacturing flows. The

manufacturing processes are divided into two parts: the front-end and back-end processes. The former includes oxidation, gas kinetics, plasma physics, CVD, plasma CVD and etching, photolithography, mask making, and doping technology. The pattern generation or mask making is included since it is relatively unfamiliar to those who work in wafer processing. Furthermore, it is widely believed that the photomask technology has to be closely integrated into wafer processing to ensure wafer production success as technologies migrate beyond 0.13 μm. The back-end process introduction, beginning with contact formation, primarily focuses on metallization and planarization and their technology evolution. Various silicide formation processes are also included in the metallization due to its inevitable role in advanced semiconductor manufacturing. Following the conventional back-end technology discussion, copper and low dielectric constant materials are also introduced as they are widely used in prevailing nanometer device manufacturing.

While most text is self-explanatory, some mathematics modeling is included occasionally to better explain the theories. Those who are in an undergraduate program or who do not have enough time to check into the mathematics can skip the modeling sessions and still gain insight into semiconductor manufacturing principles.