

Preface

We are a group of dedicated material scientists each with 15–25 years of research and development experience in the assembly and interconnect technologies of electronics. Our experience in chemical and mechanical interfacial compatibility between dissimilar materials dates back to the end of the 1980s. Since the early 1990s with the rise of the electronics industry in Finland, we focused our work increasingly into the challenges of materials, assembly technologies and reliability of portable electronics. During the last decade, our research has expanded towards high performance electronics and microsystems in different applications including automotive and biomedical devices.

We have cooperated with numerous electronics companies, including electronics OEMs and their suppliers, semiconductor companies and subcontractors. In this work, experience has shown that the development methods in this branch are often immature from the perspective of materials science and engineering. Even though much progress has taken place over the years, much of the hardware development across the value chain is still mainly experimental. The so-called “trial and error” method is widely used in this industry.

We would like to emphasize that there is an alternative development route applicable for electronics materials and process development. In this book, we present the methods one needs to master in order to have a better understanding, and control, over materials compatibility issues. Rather than trying to provide all the right answers, which we obviously also do not have, we would like to contribute educating people who are able to develop new technologies and solve problems based on a deeper understanding of materials and their interfaces. [Chapter 6](#) of this book demonstrates how this methodology can be employed in the development of reliable IC, package and board level interconnect technologies.

This book does not seek to be a collection of correct recipes. Such a database combined with the correct interpretations on materials interactions would surely be of great benefit to the microelectronics industry. Such an effort, however, lies beyond the capacity of a single research group—even after experiencing for a relatively long co-operation with the industry—as the variation of potential material systems in microelectronics is massive. Not only the possible

combinations of bill of materials, design and loading conditions are endless, but also the speed of development in these technologies is constantly bringing new material combinations for analysis. Therefore, a recipe list would be out of date soon. Further, since microelectronics hardware is composed of layers of dissimilar materials with various thicknesses and interfaces, microstructural evolution a system is highly time- and process-dependent, contributing once again to the system complexity.

This book is intended as lecture material for graduate-level students. But the book is also targeted for engineers in the electronics and microsystems technology industry. In the development work taking place inside these industries, the teams of electrical and mechanical engineers, physicists and materials scientists need to work closely together. We are convinced that by assimilating and applying the principles and methods as described in this book, these multidisciplinary teams will solve new challenges they face in the development of new material systems of future technologies in a fraction of the time they would otherwise need if applying purely empirical, “trial and error” like methods.

Interfacial Compatibility in Microelectronics

Moving Away from the Trial and Error Approach

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2012, X, 218 p., Hardcover

ISBN: 978-1-4471-2469-6