Reliability of Organic Compounds in Microelectronics and Optoelectronics

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Editors

Reliability of Organic Compounds in Microelectronics and Optoelectronics

From Physics-of-Failure to Physics-of-Degradation

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Preface

Further developments in microelectronics and optoelectronics industries necessitate materials that can withstand harsh and demanding working conditions. Reliability and lifetime assessment of organic compounds in microelectronic and/or optoelectronics devices are two key critical issues when it comes to the development of new products. Reliability is defined as the probability of failure in a system over a given lifetime, with defined operating conditions. When it comes to reliability, two factors come into play: stable performance and predictability of failures within the so-called "service lifetime". Developing accurate reliability models for microelectronic and/or optoelectronic devices requires an in-depth understanding of failure and degradation mechanisms in organic compounds. Here, organic materials relate to moulding compounds, die-attach, underfill, coatings, silicones, polycarbonate and many more. Failures in sensitive microelectronic and optoelectronic devices could have severe consequences on the functioning and profitability of many plants and infrastructures. Understanding the root-cause of failures in electronic devices and how materials degradation can contribute to such failures are therefore extremely important in developing more reliable organic materials and systems. Such knowledge can also be directly used in optimizing service conditions (voltage, temperature, environmental parameters and mechanical stresses). Having a clear picture of a failure scenario is very useful in resolving the complexity of the inter-relations between material properties and service conditions, which in case of an improper functioning result in failure. This book aims to provide a comprehensive reference into the critical subject of failure and degradation in organic materials, used in optoelectronics and microelectronics systems and devices. Key unique features of this book are:

- Documenting and introducing failure mechanisms of organic materials, used in microelectronics and optoelectronics devices
- Inter-relating ageing of organic materials to product failure and how to use available simulation techniques to optimize the design and performance of a device

- Investigating the integration of several stresses (thermal, moisture, light radiation, mechanical damage and more) into the performance of a large-scale system in several industrial domains (lighting, automotive, transport and more)
- Introducing state-of-the-art multi-scale/multi-physics simulation and experimental techniques to study failures of organic compounds in micro/optoelectronic devices

This book contains chapters related to (i) organic materials (silicones and polycarbonate), (ii) degradation mechanisms in microelectronics materials like moulding compounds, (iii) degradation mechanisms in optoelectronics components like OLED and LEDs and (iv) state-of-the art modelling and lifetime assessment techniques.

Parts of the contents in this book are first-hand results from industrial research and development projects. Reading this book, students in different engineering disciplines get an insight and develop an in-depth understanding of different failure and/or degradation mechanisms in organic materials. Also, this book will certainly be useful when it comes to training methodologies of assessing failures, degradations and reliability of different engineering materials for students. Further, students, engineers and technicians in different industrial sectors will certainly find this book interesting and informative.

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