


# Coating Materials for Electronic Applications: Polymers, Processing, Reliability, Testing (Materials and Processes for Electronic Applications)

*By James J. Licari*

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**Coating Materials for Electronic Applications: Polymers, Processing, Reliability, Testing (Materials and Processes for Electronic Applications)** By James J. Licari

This first book in the Materials and Processes for Electronics Applications series answers questions vital to the successful design and manufacturing of electronic components, modules, and systems such as:
- How can one protect electronic assemblies from prolonged high humidity, high temperatures, salt spray or other terrestrial and space environments?
- What coating types can be used to protect microelectronics in military, space, automotive, or medical environments?
- How can the chemistry of polymers be correlated to desirable physical and electrical properties?
- How can a design engineer avoid subsequent potential failures due to corrosion, metal migration, electrical degradation, outgassing?
- What are the best processes that manufacturing can use to mask, clean, prepare the surface, dispense the coating, and cure the coating?
- What quality assurance and in-process tests can be used to assure reliability?
- What government or industry specifications are available?
- How can organic coatings be selected to meet OSHA, EPA, and other regulations?

Besides a discussion of the traditional roles of coatings for moisture and environmental protection of printed circuit assemblies, this book covers dielectric coatings that provide electrical functions such as the low-dielectric-constant dielectrics used to fabricate multilayer interconnect substrates and high-frequency, high-speed circuits.

Materials engineers and chemists will benefit greatly from a chapter on the chemistry and properties of the main types of polymer coatings including: Epoxies, Polyimides, Silicones, Polyurethanes, Parylene, Benzocyclobenzene and many others.

For manufacturing personnel, there is an entire chapter of over a dozen processes for masking, cleaning, and surface preparation and a comprehensive review of

over 20 processes for the application and curing of coatings including recent extrusion, meniscus, and curtain coating methods used in processing large panels. The pros and cons of each method are given to aid the engineer in selecting the optimum method for his/her application. As a bonus, from his own experience, the author discusses some caveats that will help reduce costs and avoid failures.

Finally, the author discusses regulations of OSHA, EPA, and other government agencies which have resulted in formulation changes to meet VOC and toxicity requirements. Tables of numerous military, commercial, industry, and NASA specifications are given to help the engineer select the proper callout.

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## Editorial Review

Review
"There are not many books available on coatings for electronic assemblies ...each of the sections did explain the coating process in detail and the benefits of each system." - Bob Willis, Process Engineering Consultant Electronic Presentation Services

From the Back Cover

James J. Licari is President of AvanTeco, Whittier, CA and a consultant on materials and processes for microelectronics. Prior to this, he was Chief Scientist for Hughes' Microelectronics Division in Newport Beach, CA, where he led the development of high-density, high-performance multichip modules for high reliability military and space applications. Dr. Licari is internationally recognized for his contributions to the microelectronics field, particularly in the development of materials and processes for interconnecting and packaging hybrid microcircuits and multichip modules. At Rockwell's Autonetics Division he served as Manager of the Interconnect Systems Laboratories for 28 years. He is the recipient of six NASA awards, the annual Technical Achievement Award from IMAPS, and the Materials Engineer of the Year Award from NEPCON. Licari is also the author of four books and over 100 publications and has lectured at UCLA, Jet Propulsion Laboratories, and Oxford University, among others.

About the Author
has his own consulting firm, AvanTeco, specializing in materials and processes for electronics. He holds a BS in Chemistry from Fordham University and a PhD in Chemistry from Princeton University, where he was a DuPont Senior Fellow. His areas of expertise include materials and processes for electronic applications, primarily for high reliability systems, hybrid microcircuits, printed wiring circuits, and other interconnect packaging technologies. He is an expert on polymeric materials including adhesives, coatings, encapsulants, insulation, reliability based on failure modes and mechanisms. Dr. Licari has had a forty-year career dedicated to the study and advancement of microelectronic materials and processes.

Notable achievements throughout this career include conducting the first studies on the reliability and use of die-attach adhesives for microcircuits, which he did in the mid-1970s through the early 1980s, making industry and the government aware of the degrading effects of trace amounts of ionic contaminants in epoxy resins. He conducted early exploratory development on the use of non-noble metal (Cu) thick-film conductor pastes for thick-film ceramic circuits. He carried out the first studies on the use of Parylene as a dielectric and passivation coating for MOS devices and as a particle immobilizer for hybrid microcircuits. He developed the first photo-definable thick-film conductor and resistor pastes that were the forerunners of DuPont's Fodel process, for which he received a patent was granted in England. And he developed the first photocurable epoxy coating using cationic photoinitiation by employing a diazonium salt as the catalytic agent (U.S. 3205157) . The work was referenced as pioneering work in a review article by J.V. Crivello "The Discovery ad Development of Onium Salt Cationic Photoinitiators," J. Polymer Chemistry (1999)

## Users Review

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**Kimberly Rubio:**

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**Thomas Hawkins:**

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