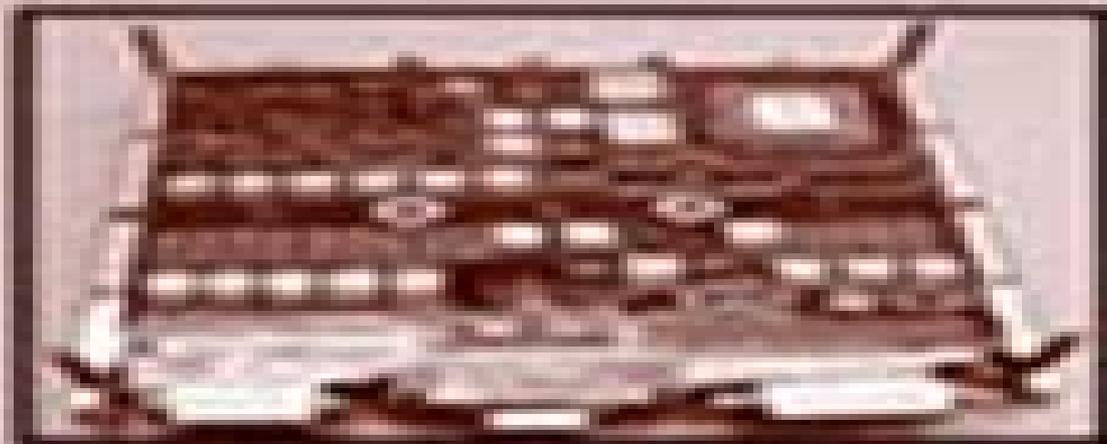


# Coating Materials for Electronic Applications

**Polymer, Processing, Reliability, Testing**



**James J. Licari**



Springer



# Coating Materials For Electronic Applications

**Charles A. Harper**



## **Coating Materials For Electronic Applications:**

Coating Materials for Electronic Applications James J. Licari, 2003-06-11 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

*Coating Materials for Electronic Applications* James J. Licari, 2003-11-27 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 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 Finally the author discusses regulations of OSHA EPA and other government agencies which have resulted in formulation changes to meet VOC and toxicity requirements

**Encapsulation Technologies for Electronic Applications** Haleh Ardebili, Michael G. Pecht, 2009-07-22 Electronics are used in a wide range of applications including computing communication biomedical

automotive military and aerospace They must operate in varying temperature and humidity environments including indoor controlled conditions and outdoor climate changes Moisture ionic contamination heat radiation and mechanical stresses are all highly detrimental to electronic devices and can lead to device failures Therefore it is essential that the electronic devices be packaged for protection from their intended environments as well as to provide handling assembly electrical and thermal considerations Currently more than 99% of microelectronic devices are plastic encapsulated Improvements in encapsulant materials and cost incentives have stretched the application boundaries for plastic electronic packages Many electronic applications that traditionally used hermetic packages such as military are now using commercial off the shelf COTS plastic packages Plastic encapsulation has the advantages of low cost smaller form factors and improved manufacturability With recent trends in environmental awareness new environmentally friendly or green encapsulant materials i e without brominated additives have emerged Plastic packages are also being considered for use in extreme high and low temperature electronics 3 D packaging and wafer level packaging WLP require unique encapsulation techniques Encapsulant materials are also being developed for micro electro mechanical systems MEMS bio MEMS bio electronics and organic light emitting diodes O LEDs This book offers a comprehensive discussion of encapsulants in electronic applications The main emphasis is on the encapsulation of microelectronic devices however the encapsulation of connectors and transformers is also addressed This book discusses 2 D and 3 D packaging and encapsulation encapsulation materials including environmentally friendly green encapsulants and the properties and characterization of encapsulants Furthermore this book provides an extensive discussion on defects and failures related to encapsulation how to analyze such defects and failures and how to apply quality assurance and qualification process for encapsulated packages This book also provides information on the trends and challenges of encapsulation and microelectronic packages including application of nanotechnology Guidance on the selection and use of encapsulants in the electronics industry with a particular focus on microelectronics Coverage of environmentally friendly green encapsulants Practical coverage of faults and defects how to analyze them and how to avoid them

**Functional Coatings for Biomedical, Energy, and Environmental Applications** Raj K. Arya, George D. Verros, J. Paulo Davim, 2024-10-08 Understand functional coatings and their role in three key industries of the future Functional coatings play a huge range of roles in industries from automotive to aerospace to electronic and beyond They offer protection performance enhancement corrosion resistance self cleaning properties and more Recent developments in the field have allowed for ever more precise optimization of functional coatings with the result that demand for these key tools is only likely to increase **Functional Coatings for Biomedical Energy and Environmental Applications** offers a comprehensive overview of these coatings and their applications in three explosively productive industries A team of expert contributors provides chapters analyzing the latest developments in this growing area of production with a particular focus on the dynamic relationship between functional coatings and their many applications The result is an interdisciplinary text which will serve

as an essential resource for researchers and industry professionals worldwide Readers will also find Analysis of functional coatings for dental implants pool boilers solar cells and many more Detailed discussion of coating properties including superhydrophobicity self cleaning controlled drug release and more Key contributions to the great environmental challenges of the twenty first century This book is a must own for researchers in chemistry engineering energy materials science and more as well as for industry professionals working with coating and other aspects of research and development in biomedical energy or environmental industries *Handbook of Polymer Coatings for Electronics* James J. Licari, Laura A. Hughes, 1990-12-31 This completely revised edition remains the only comprehensive treatise on polymer coatings for electronics Since the original edition the applications of coatings for the environmental protection of electronic systems have greatly increased largely driven by the competitive need to reduce costs weight and volume The demands for high speed circuits for the rapid processing of signals and data high density circuits for the storage and retrieval of megabits of memory and the improved reliability required of electronics for guiding and controlling weapons and space vehicles have triggered the development of many new and improved coating polymers and formulations Both the theoretical aspects of coatings molecular structure of polymer types and their correlation with electrical and physical properties and applied aspects functions deposition processes applications testing are covered in the book Over 100 proprietary coating formulations were reviewed their properties collated and tables of comparative properties prepared This book is useful as both a primer and as a handbook for collecting properties data **Adhesives Technology for Electronic Applications** James J. Licari, Dale W. Swanson, 2005-08-30 This book is unique in its comprehensive coverage of all aspects of adhesive technology for microelectronic devices and packaging from theory to bonding to test procedures In addition to general applications such as dies substrate and lid and chip stack attachments the book includes new developments in anisotropic electrically conductive and underfill adhesives Rapid curing methods such as UV microwave and moisture which comply with current environmental and energy requirements are covered Over 80 tables and 120 figures provide a wealth of data on properties performance and reliability Also included are examples of commercially available adhesives suppliers and equipment Each chapter provides comprehensive references *Application of Fracture Mechanics in Electronic Packaging and Materials* Tien Y. Wu, 1995 Thirty one technical papers representing a balance between university research and industrial practice the results of which advance the quality and reliability of electronic products through fracture mechanics Among the range of topics discussed at the symposium were analytical and numerical anal *Net shape technology in aerospace structures*, 1986 *Electronic Materials and Processes Handbook* Charles A. Harper, 2003-08-07 Electronic materials are the actual semiconductors plastics metals and ceramics that make up the chips and packages from which we construct today s cell phones palmtops and PDAs The switch in applications from PCs to smaller communications devices has driven the micro miniaturization trend in electronics which in turn has created a new set of challenges in creating materials to meet their specifications This new

edition the first update of the handbook since 1993 is a complete rewrite reflecting the great importance of engineering materials for thermal management and flexibility and micro miniature sizes This new handbook will be an invaluable tool to anyone working electronic packaging fabrication or assembly design Adhesives, Sealants, and Coatings for the Electronics Industry Ernest W. Flick,1986 The second edition of this widely accepted industrial guide contains descriptions of more than 2 500 adhesives sealants and coatings which are available to the electronics and related industries The book greatly expanded from the previous edition is the result of information received from 80 manufacturers and distributors of these products The data including product specifications represent selections from the manufacturers descriptions made at no cost to nor influence from the makers or distributors of these materials Only the most recent information has been included It is believed that all of the products listed are currently available which will be of interest to readers concerned with product discontinuances **Handbook of Product Design for Manufacturing** James G. Bralla,1986 A Practical Guide to Low Cost Production offers a detailed overview of common manufacturing processes for the designer or manufacturing engineer Covers a full range of processes from metal stamping forging casting molding thermoforming and more Specifies optimum material grades and dimensional tolerance data for each production process *Electronic Packaging and Production* ,1992 **Thomas Register of American Manufacturers** ,2003 Vols for 1970 71 includes manufacturers catalogs Metals Handbook American Society for Metals,1964 Electronics ,1945 June issues 1941 44 and Nov issue 1945 include a buyers guide section *Polymers for High Technology* M. J. Bowden,American Chemical Society. Meeting,1987 Examines the ongoing electronic and photonic revolution and the fundamental chemically related principles underlying these technologies Provides reports on definitive advances in relatively mature technologies and offers a better understanding of the new materials and processes needed to meet the demands of tomorrow s technology Will serve as the stepping stone to further advances in polymer technology for chemists in both the industrial and academic sphere Catalog of Government Patents ,1981 **Advanced Materials & Processes** ,1991 **A Functional Description of the Edvac [an Automatically-sequence Serial Binary Electronic Digital Computer** Moore School of Electrical Engineering,1949 **Metallic Coatings for Corrosion Control** V. E. Carter,1977 Metallic Coatings for Corrosion Control describes how metal coatings can control corrosion the selection process preparations suitability limitations and how coatings are applied The book reviews the nature of corrosion the forms of corrosion even general uneven general even local narrow pits cracking electrochemical mechanism of corrosion effects of discontinuities in coatings and economic considerations of coating It describes pretreatments such as removal of superficial corrosion abrading polishing the coating processes molten or spray application chemical or vapor deposition diffusion coating and also coating performance The rate of corrosion on different metals such as aluminum cadmium copper gold silver or tin depends on the presence of an oxide film solubility electrodeposits or tarnish blackening Gold is resistant to corrosion and tarnishing except in aqua regia The

book recommends the following when the engineer is selecting a type of coating the environment where it is exposed the service life required the substrate material shape or size of the article its decorative appeal mechanical factors and if there will be any subsequent fabrication The book is useful for students of civil structural and mechanical engineering Designers and technicians of industrial machinery or maritime equipment will also profit from reading it

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web problem 4 2 7 4 2 7 the arrangement of atoms in several biologically important molecules is given here complete the lewis structures of these molecules by adding multiple bonds and lone pairs do not add any more atoms a the amino acid serine b urea c pyruvic acid d uracil e carbonic acid

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web nov 14 2023 show all resonance structures possible use formal charges to pick the best form if necessary the following molecule has two lewis dot formulas write one that uses 8 electrons about the central atom and one that expands the natat

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web mar 27 2023 a the lewis structure for water is represented by the given option a in this structure the oxygen atom is in the center and is bonded to two hydrogen atoms the oxygen atom has two lone pairs of electrons this structure follows the octet rule where each atom has a full valence shell with eight electrons

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web lewis structures represent the valence electrons present in the molecule as lone pairs unshared electrons drawn as dots or bonds shared electrons drawn as lines procedure for drawing lewis structures add up the total number of valence electrons that each atom contributes to the molecule polyatomic ion

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web the pcl 3 lewis structure has the typical case of phosphorus p in the center with 3 bonds to 3 other atoms phosphorus is from the same column as nitrogen in the periodic table meaning that p and n generally have the same bonding structure note the lone pair dots without bonds on top of p just like for n in the previous example for nh 3 chlorine cl

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web step 1 figure out how many electrons the molecule must have based on the number of valence electrons in each atom when drawing the structure of an ion be sure to add subtract electrons to account for the charge step 2 connect the atoms to each other with single bonds to form a skeleton structure

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web this exercise required us to take the formulas in the data table and calculate the number of valence electrons using the periodic table draw its lewis structure on paper build the molecular model and record a photo list the number of bonds and lone pairs surrounding the central atom and lastly identify the structure geometry