Polymers for microelectronics

By Gerhard Maier

A variety of polymers have been proposed for use as materials with low dielectric constants for applications in microelectronics. Polyimides, heteroaromatic polymers, poly(aryl ether)s, fluoropolymers, hydrocarbon polymers without any polar groups, films deposited from the gas phase by chemical vapor deposition, plasma enhanced chemical vapor deposition and other techniques are discussed. Based on the properties described, and the requirements for applications as intermetal dielectric material, conclusions regarding the possibilities for further developments are drawn.

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Image above shows an interconnect array[1].

The continuous advancement of microelectronics in all fields of technology has become a basic fact of our daily life. Increasingly complex tasks are performed by computers, requiring more memory capacity and faster processing speeds. This constant need to develop more highly integrated microchips is expressed by Moore's law, which states that the capacity of the most highly developed random access memory (RAM) chips increases by a factor of four every three years. This is achieved by decreasing the size of devices on chips in each new generation by a factor of two and simultaneously increasing the size of the silicon chip ('die') by the same factor[1].

This trend requires constant improvements in processing the materials used for transistors, capacitors and other devices. From the viewpoint of polymer chemistry, the most important task was the development of photoresists to allow reliable structuring in the micron and submicron range. Initially, it was anticipated that electron beam or γ-radiation would be necessary to create structures with sufficient resolution below 1 μm. However, improved sensitivity and contrast of the photoresists by introducing 'chemically amplified' resists, as well as new imaging technologies, structures even below 0.2 μm are likely to be created using UV-lasers such as the 157 nm fluorine excimer laser.

It is now no longer sufficient to adapt processing methods for known materials to the requirements of ever decreasing devices. As devices become smaller, the distance between electrically conducting interconnect lines decreases. Below a certain distance, these lines start to influence each other

Polymers In Microelectronics

David S. Soane,Zoya Martynenko

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Polymers in Microelectronics David S. Soane,Zoya Martynenko,1989 **Polymers for Microelectronics** ,1994 *Handbook of Polymers in Electronics* Bansi D. Malhotra,2001-12-31 The Handbook of Polymers in Electronics has been designed to discuss the novel ways in which polymers can be used in the rapidly growing electronics industry It provides discussion of the preparation and characterisation of suitable polymeric materials and their current and potential applications coupled with the fundamentals of electrical optical and photophysical properties It will thus serve the needs of those already active in the electronics field as well as new entrants to the industry Polymers for Microelectronics and Nanoelectronics Qinghuang Lin,R. A. Pearson,Jeffrey C. Hedrick,2004 Discusses patterning insulating and packaging polymeric materials for the 150 billion microelectronics industry as well as the rapidly emerging nanoelectronics and organic electronics industries Chapters discuss patterning insulating and packaging polymeric materials as well as organic materials for nanoelectronics organic electronics and optoelectronics This book covers the synthesis characterization structure property relationship performance and applications of these materials Handbook of Conducting Polymers, Second Edition, Terje A. Skotheim,1997-11-24 Discussing theory and transport synthesis processing properties and applications this second edition of a standard resource covers advances in the field of electrically conducting polymers and contains more than 1500 drawings photographs tables and equations Maintaining the style of presentation and depth of coverage that made the first edition so popular it contains the authoritative contributions of an interdisciplinary team of world renowned experts encompassing the fields of chemistry physics materials science and engineering The Handbook of Conducting Polymers highlights progress delineates improvements and examines novel tools for polymer and materials scientists *Materials Science of High Temperature Polymers for Microelectronics: Volume 227* D. T. Grubb,Itaru Mita,D. Y. Yoon,1991 The MRS Symposium Proceeding series is an internationally recognised reference suitable for researchers and practitioners

Polymers for Microelectronics L. F. Thompson,1994 Developed from a symposium at the 203rd Meeting of the ACS in San Francisco April 1992 this volume presents new information on advanced polymers for applications in the manufacture of electronic devices and systems The 38 chapter papers are organized in four sections chemically amplified resists top surface imaging and dry development resists electron beam X ray and photoresists and polyimides and dielectric polymers Annotation copyright by Book News Inc Portland OR **Polymer Electronics** Mark Geoghegan,Georges Hadziioannou,2013-04-04 Polymer electronics is the science behind many important new developments in technology such as the flexible electronic display e ink and many new developments in transistor technology Solar cells light emitting diodes and transistors are all areas where plastic electronics is likely to or is already having a serious impact on our daily lives With polymer transistors and light emitting diodes now being commercialised there is a clear need for a pedagogic text that discusses the subject in a clear and concise fashion suitable for senior undergraduate and graduate students The content

builds on what has been learnt in an elementary core course in solid state physics and electronic behaviour but care has been taken to ensure that important aspects such as the synthesis of these polymers are not overlooked The chemistry is treated in a manner appropriate to students of physics Polymer Electronics presents a thorough discussion of the physics and chemistry behind this new and important area of science appealing to all physical scientists with an interest in the field **Polymers in Electronics** Zulkifli Ahmad,M. Khalil Abdullah,Muhammad Zeshan Ali,Mohamad Adzhar Md Zawawi,2023-07-28 Polymers in Electronics Optoelectronic Properties Design Fabrication and Applications brings together the fundamentals and latest advances in polymeric materials for electronic device applications supporting researchers scientists and advanced students and approaching the topic from a range of disciplines The book begins by introducing polymeric materials their dielectric optical and thermal properties and the essential principles and techniques for polymers as applied to electronics This is followed by detailed coverage of the key steps in the preparation of polymeric materials for opto electronic devices including fabrication methods materials design rheology encapsulation and conductive polymer mechanisms The final part of the book focuses on the latest developments in advanced devices covering the areas of photovoltaics transistors light emitting diodes and stretchable electronics In addition it explains mechanisms design fabrication techniques and end applications This is a highly valuable resource for researchers advanced students engineers and R D professionals from a range of disciplines Offers introductory coverage of polymeric materials for electronics including principles design properties fabrication and applications Focuses on key issues such as materials selection structure property relationships and challenges in application Explores advanced applications of polymers in photovoltaics transistors sensors light emitting diodes and stretchable electronics **Polymers in Electronics 2007** ,2007 This conference saw presentations from all parts of the electronics industry s materials supply chain from raw materials to finished products and offered an opportunity to learn more about both traditional and new polymer materials their markets manufacturing processes and applications It also covered the impact of legislation the need to recycle and other polymer related challenges and opportunities for the industry **Studies in Polymers for Microelectronics** Samson Ally Jenekhe,1985 *Polymers in Organic Electronics* Sulaiman Khalifeh,2020-04-01 Polymers in Organic Electronics Polymer Selection for Electronic Mechatronic and Optoelectronic Systems provides readers with vital data guidelines and techniques for optimally designing organic electronic systems using novel polymers The book classifies polymer families types complexes composites nanocomposites compounds and small molecules while also providing an introduction to the fundamental principles of polymers and electronics Features information on concepts and optimized types of electronics and a classification system of electronic polymers including piezoelectric and pyroelectric optoelectronic mechatronic organic electronic complexes and more The book is designed to help readers select the optimized material for structuring their organic electronic system Chapters discuss the most common properties of electronic polymers methods of optimization and polymeric structured printed circuit boards The polymeric

structures of optoelectronics and photonics are covered and the book concludes with a chapter emphasizing the importance of polymeric structures for packaging of electronic devices Provides key identifying details on a range of polymers micro polymers nano polymers resins hydrocarbons and oligomers Covers the most common electrical electronic and optical properties of electronic polymers Describes the underlying theories on the mechanics of polymer conductivity Discusses polymeric structured printed circuit boards including their rapid prototyping and optimizing their polymeric structures Shows optimization methods for both polymeric structures of organic active electronic components and organic passive electronic components *Micro- and Opto-Electronic Materials and Structures: Physics, Mechanics, Design, Reliability, Packaging* Ephraim Suhir,Y.C. Lee,C.P. Wong,2007-05-26 This handbook provides the most comprehensive up to date and easy to apply information on the physics mechanics reliability and packaging of micro and opto electronic materials It details their assemblies structures and systems and each chapter contains a summary of the state of the art in a particular field The book provides practical recommendations on how to apply current knowledge and technology to design and manufacture It further describes how to operate a viable reliable and cost effective electronic component or photonic device and how to make such a device into a successful commercial product *Conducting Polymers with Micro or Nanometer Structure* Meixiang Wan,2009-03-15 Conducting Polymers with Micro or Nanometer Structure describes a topic discovered by three winners of the Nobel Prize in Chemistry in 2000 Alan J Heeger University of California at Santa Barbara Alan G MacDiarmid at the University of Pennsylvania and Hideki Shirakawa at the University of Tsukuba Since then the unique properties of conducting polymers have led to promising applications in functional materials and technologies The book first briefly summarizes the main concepts of conducting polymers before introducing micro nanostructured conducting polymers dealing with their synthesis structural characterizations formation mechanisms physical and chemical properties and potential applications in nanomaterials and nanotechnology The book is intended for researchers in the related fields of chemistry physics materials nanomaterials and nanodevices Meixiang Wan is a professor at the Institute of Chemistry Chinese Academy of Sciences Beijing **Polymers for Microelectronics - Science and Technology** Yoneho Tabata,Itaru Mita,Saburo Nonogaki,Kazuyuki Horie,Seiichi Tagawa,1990-11-10 In this book an international team of authors from both industrial and academic research consider recent progress in polymers for microelectronics They offer detailed coverage of fundamental and applied research on resists and related compounds polyimides and other functional polymers for microelectronics new photoresponsive polymers for optical memory and related applications Chemists and physicists active in this field will find here an exhaustive state of the art report on one of the key elements of advanced technologies **Polymers for Microelectronics - Science and Technology** Yoneho Tabata,Itaru Mita,Saburo Nonogaki,Kazuyuki Horie,Seiichi Tagawa,1990-11-10 In this book an international team of authors from both industrial and academic research consider recent progress in polymers for microelectronics They offer detailed coverage of fundamental and applied research on resists and

related compounds polyimides and other functional polymers for microelectronics new photoresponsive polymers for optical memory and related applications Chemists and physicists active in this field will find here an exhaustive state of the art report on one of the key elements of advanced technologies **Polymers for Electronic Applications** J.H. Lai,2018-01-18 The object of this book is to review and to discuss some important applications of polymers in electronics The first three chapters discuss the current primary applications of polymers in semiconductor device manufacturing polymers as resist materials for integrated circuit fabrication polyimides as electronics packaging materials and polymers as integrated circuits encapsulates *Special Polymers for Electronics and Optoelectronics* J.A. Chilton,M. Goosey,2012-12-06 Commercially successful fully synthetic polymeric materials were pro duced in the early years of this century the first example being Bakelite This was made from phenol and formaldehyde by Leo Bakeland in 1909 Before the end of the 1920s a large number of other synthetic polymers had been created including polyvinyl chloride and urea formaldehyde Today there are literally hundreds of synthetic polymers commercially available with ranges of properties making them suitable for applications in many industrial sectors including the electrical and electronics industries In many instances the driving force behind the development of new materials actually came from the electronics industry and today s advanced electronics would be inconceivable without these materials For many years polymers have been widely used in all sectors of the electronics industry From the early days of the semiconductor industry to the current state of the art polymers have provided the enabling technologies that have fuelled the inexorable and rapid development of advanced electronic and optoelectronic devices *Polymers for Electricity and Electronics* Jiri George Drobny,2011-12-14 The comprehensive practical book that explores the principles properties and applications of electrical polymers The electrical properties of polymers present almost limitless possibilities for industrial research and development and this book provides an in depth look at these remarkable molecules In addition to traditional applications in insulating materials wires and cables electrical polymers are increasingly being used in a range of emerging technologies Presenting a comprehensive overview of how electrical polymers function and how they can be applied in the electronics automotive medical and military fields Polymers for Electricity and Electronics Materials Properties and Applications presents intensive and accessible coverage with a focus on practical applications Including examples of state of the art scientific issues the book evaluates new technologies such as light emitting diodes molecular electronics liquid crystals nanotechnology optical fibers and soft electronics and explains the advantages of conductive polymers as well as their processibility and commercial uses This book is an essential resource for anyone working with or interested in polymers and polymer science In addition appendices that detail the electrical properties of selected polymers as well as list additional ASTM and corresponding international testing standards and methods for testing electrical properties are also included Microelectronic Materials C.R.M. Grovenor,2017-10-05 This practical book shows how an understanding of structure thermodynamics and electrical properties can explain some of the choices of materials

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