

Coating of Textile Fabrics with Conductive Polymers for Smart Textile Applications

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ABSTRACT

Conductive surfaces on woven fabrics were obtained by knife-over-roll coating in laboratory small-scale equipment and continuously in a pilot plant. Commercially available inherently conductive polymers (polyaniline, polythiophene and polypyrrole) were mixed with an acrylic binder polymer, and coated on a polyester fabric. The concentration of the conductive polymer and number of coated layers were varied with the aim to reach conductivity on a surface which could withstand aging and mechanical stress. The surface resistivity, surface analysis, appearance of the surface and behaviour of the coating paste were studied.

AUTHOR KEYWORDS

Conductive surfaces, textile coatings, polyaniline, polypyrrole, polythiophene, surface resistivity, surface characteristics.

INTRODUCTION

The possibility to integrate electronics in textiles is a growing research objective, as many commercially important applications can be seen. Electronic and smart textiles have applications in military, medical, leisure and sports as well as in the industrial textile areas. Many of the current prototypes and demonstrators are cumbersome and awkward in use and wear, and impractical for daily use. To develop more user friendly wearable smart and electronic textiles new textile fabrics and fibres must be developed, and taken into commercial production. Metallic and optical fibres, conductive yarns and fabrics, conductive coatings and inks are today under development. These must however

be tailored to meet the demands set by the textile manufacturing and design. Conductivity is a main requirement in smart and electronic textiles, and there are several options for achieving this [1]. Metal fibres in the form of thin metal filaments can be used, but these are brittle, heavier and more difficult to process than conventional textile fibres. Coating of textile fibres with metallic salts is another option, but these have limited stability during laundering. The development of intrinsically conductive polymers (ICP) has opened up new possibilities for conductive textile materials. These polymers are conjugated polymers which electrical conductivity is dramatically increased by doping [2]. In the doping a small amount of chemical agent is added, and the electronic structure is changed. The doping process is reversible, and involves a redox process. Conductive polymers are provided both as solid compounds or liquid dispersions or solutions. The liquid versions can easily be applied onto a textile substrate by coating methods. There are several reports of this concept in the literature. Polyester fabrics have been coated with polypyrrole (PPy) for obtaining heat generation textiles. The fabric could generate heat when a voltage was applied to the fabric [3]. In-situ polymerisation of the conductive polymer on the textile surface has also been reported. Poly-3,4-ethylenedioxythiophene (PEDOT) and PPy have been deposited by chemical and electrochemical oxidation on a polyester textile [4]. These textiles showed also decrease in conductivity upon stretching, thus enabling the textiles to be used as strain sensors. Similar attempts have also been reported by others [5,6].

By applying conductive coatings on textiles, a novel and technically interesting textile material should be obtained. Textiles are frequently coated and printed to get different surface appearances and properties. There has however not been done many investigations about the possibilities to apply conductive coatings on textile by similar methods as used in the textile industry. Although the concept seems straightforward, there are several technical obstacles which must be overcome.

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Advances in Polymer Coated Textiles Gueneri Akovali, 2012-07-24 Polymer coated textiles are known as engineered composite materials at macro scale Coating can offer significant improvements to the substrate mainly of the physical like impermeability and fabric abrasion and or of overall chemical properties as well as the appearance by combining advantages of the components Polymer coated systems employ various kinds of textile substrate structures available mostly of technical textiles Since there are a number of possibilities for different types of polymers and their combinations textile structures as well as their combinations are possible it is widely open to creativities and almost every day some new innovative application is being introduced Polymer coated textile industry being parallel to the developments in the textile research is so dynamic that today applications like reactive coatings with nanoparticles with self cleaning self sterilizing surfaces systems with conductive polymer coatings to provide EM shielding electronic textile systems with body monitoring properties environmental responsive systems etc are already somewhat classical and are considered almost left in the shade of incoming new developments This book is an up to date summary of the subject by considering the passage from conventional to emerging technologies Criteria for selection of the coat and textile are considered and the manufacturing basics of the system are summarized Emerging technologies and applications including smart intelligent and nanostructured applications are completed by testing and quality control methods of these systems The book is written for all that are interested in this interdisciplinary area it certainly will prove to be of great help to textile and polymer technologists to engineers to scientists as well as to students

Advances in Functional and Protective Textiles Shahid Ul Islam, Bhupendra Singh Butola, 2020-06-11 *Advances in Functional and Protective Textiles* explores the latest research in the use of textile materials for protective clothing The book s international roster of researchers in industry and academia describe innovative applications in defense medical sports fire protection radiation protection and more This book is an invaluable resource for readers seeking to produce textiles with self cleaning antimicrobial super hydrophobic UV protective insect repellent flame retardant or anti felting properties Particular attention is given to textile fibers including cotton wool viscose and other synthetic fibers whose properties solve many problems Sustainable approaches to the processing of textiles for protective properties are also addressed as are hazards Introduces the advanced testing and modeling methods that are necessary for the production of protective textiles Describes the properties of the latest advanced chemicals and materials used to make protective textiles and clothing Covers every step in the development of protective clothing from the engineering of novel materials to advanced fabrication methodologies and applications

Intelligent Textiles and Clothing H Mattila, 2006-07-28 The use of intelligent textiles in clothing is an exciting new field with wide ranging applications Intelligent textiles and clothing summarises some of the main types of intelligent textiles and their uses Part one of the book reviews phase change materials PCM their role in such areas as thermal regulation and ways they can be integrated into outdoor and other types of

clothing The second part of the book discusses shape memory materials SMM and their applications in medical textiles clothing and composite materials Part three deals with chromic colour change and conductive materials and their use in such areas as sensors within clothing The final part of the book looks at current and potential applications including work wear and medical applications With its distinguished editor and international team of contributors Intelligent textiles and clothing is an essential guide for textile manufacturers in such areas as specialist clothing for example protective sports and outdoor clothing as well as medical textiles Summarises the main types of intelligent textiles and their uses Reviews phase change materials and their role in clothing Discusses shape memory materials and their applications

Advances in Electrically Conductive Textiles Subhankar Maity, Pintu Pandit, Saptarshi Maiti, 2024-11-15 Nonmetallic electroconductive textiles unlike metals offer flexibility durability moldability and lightweight attributes A brilliant quality of these textiles is the capability to alter conductivity through various external stimuli e g strain torsion pH humidity to suit a specific application such as sensors heating garments EMI shielding energy harvesting devices and wearable electronics Based on these concepts Advances in Electrically Conductive Textiles Materials Characterization and Applications has been structured into three main sections Section I contains chapters discussing the various preparation methods of electroconductive textiles Section II contains chapters on their characteristics and features and Section III details the end use applications and sustainability of these textiles Explores strategies and methods in the development of electroconductive textile composites Investigates features of nonmetallic conductive textiles prepared from graphene conductive polymers MXene and carbon nanotubes Examines the application of electroconductive textiles for heat generation EMI shielding sensors antimicrobial filtration energy storage energy harvesting and smart textiles

Encyclopedia of Polymer Applications, 3 Volume Set Munmaya Mishra, 2018-12-17 Undoubtedly the applications of polymers are rapidly evolving Technology is continually changing and quickly advancing as polymers are needed to solve a variety of day to day challenges leading to improvements in quality of life The Encyclopedia of Polymer Applications presents state of the art research and development on the applications of polymers This groundbreaking work provides important overviews to help stimulate further advancements in all areas of polymers This comprehensive multi volume reference includes articles contributed from a diverse and global team of renowned researchers It offers a broad based perspective on a multitude of topics in a variety of applications as well as detailed research information figures tables illustrations and references The encyclopedia provides introductions classifications properties selection types technologies shelf life recycling testing and applications for each of the entries where applicable It features critical content for both novices and experts including engineers scientists polymer scientists materials scientists biomedical engineers macromolecular chemists researchers and students as well as interested readers in academia industry and research institutions

Nanosensors and Nanodevices for Smart Multifunctional Textiles Andrea Ehrmann, Phuong Nguyen Tri, Tuan Anh Nguyen, 2020-09-16 Nanotechnology has been incorporated into a wide range of

garments to improve the durability of clothing apparel and create new properties for a special end used application It also incorporates wearable electronics into clothing to make it smarter Smart nano textiles refers to the uses and integration of smart nanocoatings nanosensors and nanodevices in multifunctional textiles since they are both low cost and have low power consumption Various organic and inorganic nanomaterials can be used in garments to improve their properties and create new properties such as anti bacterial superhydrophobic auto cleaning self cleaning stain repellent wrinkle free static eliminating fire resistant and electrically conductive properties This book focuses on the fundamental concepts and approaches for the preparation of smart nanotextiles their properties and their applications in multifarious industries including smart garments biomedicine construction building materials energy conversion storage automotive aerospace industries and agriculture Shows how nanotechnology is being used to be able to enhance textiles with smart properties including anti bacterial superhydrophobic and auto cleaning Explores which nanomaterial types are most compatible with particular textile classes Assesses the major challenges of integrating nanosensors and nanodevices into textiles Smart and Functional Textiles Bapan Adak, Samrat Mukhopadhyay, 2023-04-03 Smart and Functional Textiles is an application oriented book covering a wide range of areas from multifunctional nanofinished textiles coated and laminated textiles wearable e textiles textile based sensors and actuators thermoregulating textiles to smart medical textiles and stimuli responsive textiles It also includes chapters on 3D printed smart textiles automotive smart textiles smart textiles in military and defense as well as functional textiles used in care and diagnosis of Covid 19

Applications of Advanced Green Materials Shakeel Ahmed, 2020-10-22 Applications of Advanced Green Materials provides a comprehensive and authoritative review on recent advancement in green materials in various applications Each chapter is focused on a specific application of advanced green materials from packaging to sensor technology biomedical to environmental applications textile to catalysis to electronic shielding applications supercapacitors drug delivery tissue engineering bioelectronic gas storage and separation etc This book also discusses life cycle assessment and circular economy of green materials and their future prospective The book is unique with contributions from renowned scientists working on biopolymers and biocomposites bioactive and biodegradable materials composites and metallic natural materials This book is an essential resource for academicians researchers students and professionals interested in exploring potential of advanced green materials Includes up to date information on applications of advanced green materials Each chapter is specifically discussing a particular application with examples Present a unified approach to discuss in detail about origin synthesis and application of green materials

Protective Textiles from Natural Resources Md. Ibrahim H. Mondal, 2022-06-15 Protective Textiles from Natural Resources provides systematic coverage of the fundamentals production methods processing techniques characterization techniques properties and applications of natural textile products for protective purposes The subject of this book is an important kind of technical textile designed to protect the wearer from injuries illness and death They offer enhanced

protection against phenomena including heat cold flame chemical biological nuclear agents radiation disaster and even ballistics As no single type of clothing can be adequate for all kinds of protection extensive research is carried out to develop protective clothing for specialized civilian and military applications The latest research on the use of natural fibres in PPE is also covered which could make a significant contribution to the fight against the spread of COVID 19 This comprehensive guide explores a wide variety of themes from material processing and design to finished products through protection against specific hazards to specific applications including all significant new developments on natural materials for protective textiles Explains the latest technologies related to fibre extraction from natural sources chemical treatments weave constructions fabric finishes and coatings Includes the latest research on natural fibers in personal protective equipment PPE to protect wearers from bacterial and viral contamination Explains the state of the art in testing methods and standards for protective clothing Textiles Magazine ,2001 **Resistivity of Conductive Polymer-coated Fabric** ,2003 Preparation of conductive polymer coated fabrics was carried out by admicellar polymerization with and without addition of salt By this method thin layers of conducting polymers namely polyaniline polypyrrole polythiophene and poly N methylpyrrole were formed on cotton and polyester fabrics via a surfactant template The surface morphology of the treated fabrics was examined using scanning electron microscopy SEM In addition the effects of monomer concentration oxidant monomer ratio and the amount of salt on the resistivity of the resulting fabrics were studied The results showed that the apparent surface and volume resistivities decreased with increasing in monomer concentration in the range 5 15 mM There was no significant difference in resistivity values when oxidant monomer ratios of 1 1 and 2 1 were used Addition of 0 5 M NaCl was found to decrease the resistivity of the resulting fabrics significantly SEM micrographs of the treated fabrics show distinctive film like coatings on the fiber surfaces The lowest resistivity obtained with polypyrrole was around 106 ohms **Handbook of Organic Conductive Molecules and Polymers, Conductive Polymers** Hari Singh Nalwa,1997 Conductive polymers polymers that conduct electricity have applications in telecommunications electronics materials science chemistry and physics The four self contained volumes of this handbook thoroughly explore all aspects of conductive polymers including chemical and physical properties technology and applications **8th International Conference on Material Science and Smart Materials (MSSM) - selected papers** Mohamad Ramadan,Abdul Ghani Olabi,2023-10-19 Selected peer reviewed full text papers from the 8th International Conference on Materials Science and Smart Materials MSSM 2022 Selected peer reviewed full text papers from the 8th International Conference on Materials Science and Smart Materials MSSM 2022 July 11 13 2022 London United Kingdom **The Indian Textile Journal** Sorabji M. Rutnagur,2010 **Textile Technology Digest** ,2002 **Science and Government Report** ,2001 **Encyclopedia of Chemical Technology: Elastomers, polyisoprene to expert systems** ,1994 **Conference Proceedings** Society of Plastics Engineers. Technical Conference,1993 **Synthetic Metals** ,1996 **Ultra Materials** George M Beylerian,A Dent,2007-10-30 Smart substances

intelligent interfaces sensory surfaces self cleaning materials and inflatable membranes are redefining our environment Using groundbreaking recent products and projects this exceptional book reveals the application of new materials in architecture interiors fashion textiles and product and vehicle design Special sections are devoted to interviews with designers such as David Adjaye Hussein Chalayan and Marcel Wanders who have made particular use of new materials an analysis of the transformative science being employed based on fibre technologies sustainability biomimicry nanotechnology and fabric innovation and a window into the future drawing on the ideas of leading experts The book includes a showcase of 400 of the newest materials an in depth glossary and a comprehensive directory of designers material organizations and design publications as well as details of professional competitions awards and fellowships and an index of new materials and their properties

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