A pantograph is an apparatus mounted on the roof of an electric train, tram, or electric bus to transmit power through contact with an overhead catenary wire. This system consists of an upper, weight-carrying wire (known as a catenary) from which is suspended a contact wire. The pantograph is spring-loaded and pushes a contact shoe up against the underside of the contact wire to draw the current needed to run the train. The steel rails of the tracks act as the electrical return. As the train moves, the contact shoe slides along the wire. This motion can set up mechanical standing waves in the wires, which break the contact, creating arcing, and eroding the sliding contact. Pantographs with overhead wires are now the dominant form of current collection for modern electric trains because, although more fragile than a third-rail system, they allow the use of higher voltages. Pantographs are typically operated by compressed air from the vehicle’s braking system to raise the unit and hold it against the conductor. For high-voltage systems, the same air supply is used to “blow out” the electric arc when roof-mounted circuit breakers are used.

This book introduces pantographs, contact lines, and their interactions in many areas including mechanical design, dynamics, materials, sliding, and arcing contacts. The reader will be able to understand the basic theories of interaction between the pantograph and contact lines. It covers the fundamentals of operation, system design, construction and maintenance, and safety.

After an overview of electric train systems and all the requirements, design details are explored for each part of the pantograph and contact line system. The basic structure of the pantograph is reviewed including details about electric performance, contact force, and aerodynamic force for low-, medium-, and high-speed trains. The book continues with geometrical details of a pantograph that cover pantograph head design, lateral shift of the contact wire, properties of the contact wire, and examples from typical high-speed railways. The dynamic interaction between the pantograph and the contact line are reviewed including vibration, standing waves, Doppler effects, and mechanical effects. Simulation models are used to model these dynamic interactions. Requirements for contact materials and desired properties are described in detail for both the sliding contact block and the contact wire. Electrical properties cover static as well as dynamic properties including arcing properties, thermal analysis of arc erosion, friction abrasion mechanisms, and heat conduction models for a sliding contact. Details are presented for the design and construction of a pantograph and contact line system. There is also a chapter on techniques for making measurements of characteristics important to these systems including frequency response, structure analysis, spacial position of contact wires, contact line elasticity, contact forces, and contact line temperatures.

This book is very practical and loaded with interesting design information that would be very useful to anyone designing these types of systems. However, in a few instances, some of the translation and grammar choices could be improved, and there are no references justifying some of the quantities used, especially for some of the arcing quantities used in equations to calculate, for example, temperature rise in conductors. Overall, the writing is clear and easy to follow.

Pantograph and Contact Line System would be useful for our readers who are interested in catenary and pantograph-related areas, such as college teachers and students, researchers, and other professionals involved in the design, manufacture, construction, operation, and maintenance of pantographs and catenary systems.
also be used to gain a visual understanding of physics and engineering concepts.

Typically, ANSYS users break down larger structures into small components that are each modeled and tested individually. A user may start by defining the dimensions of an object and then adding pressure, temperature, weight, and other physical properties. Finally, the ANSYS software simulates and analyzes movement, fatigue, fractures, fluid flow, temperature distribution, electromagnetic efficiency, and other effects over time.

ANSYS is a leader in the finite element method software industry and has very sophisticated algorithms and detailed programming steps—it can take an engineering student or working professional quite a long time to fully develop the skills necessary to produce reliable simulation models. This book will help those who want to learn how to use ANSYS and FLUENT, the computational fluid dynamics (CFD) component of ANSYS.

This book is a tutorial, learn-by-example type of book, meaning that each chapter provides step-by-step examples to show how various types of engineering problems are solved using the ANSYS software. It is most appropriate for university students studying engineering or for working professionals who wish to learn how to use ANSYS. The book only describes ANSYS software, version 17, and FLUENT. Although the underlying fundamentals do not change from version to version, there are subtle differences. Software updates can occur quite rapidly. Version 19 was released in February 2018.

This book covers various examples of engineering problems that can be solved with ANSYS. It starts out by introducing the reader to fundamental concepts of the finite element method. An overview of ANSYS software is presented including preprocessing, solution, and postprocessing stages. The remainder of the book provides step-by-step solutions for developing simulation models in various engineering disciplines. These include stress analysis, machinery dynamics, fluid dynamics, thermo-mechanics, and surface mechanics of machine elements. Technical details and the necessary equations used to model each problem are presented along with step-by-step instructions for setting up the problem in the software.

If you want to quickly learn to solve problems using ANSYS software, this book is a great way to develop the necessary skills to set up problems and become familiar with the software. If your problem happens to be the same or very similar to a problem presented in the book, then this book would be the perfect way to get started quickly.

Thermosets—Structure, Properties, and Applications, 2nd Edition

Q. Guo, Editor
Elsevier
50 Hampshire Street, 5th Floor
Cambridge, MA 02139
Phone: +1 619 231 6616
Fax: +1 619 699 6422
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Understanding the morphology and properties of thermoset materials is vital for the proper selection of a thermoset material for a given application. Understanding the material structure and how it relates to a material’s properties and how processing methods affect these properties and structure are critical for many applications.

This book focuses on how structure and properties of various thermoset materials affect the material and application. It contains two parts: Part I structure and properties and Part II applications. Part I deals with a comprehensive overview of thermosets, covering morphology, properties, processing, mechanical and thermal properties, curing process, phase separation in thermoplastic-modified thermosets, structure–property relationship of thermoset nanocomposites, and toughening of thermoset structures using nanomaterials.

Part II covers applications in the following areas: building and construction industry, aerospace, adhesives, coatings, thermal insulation, electrical, pipeline corrosion protection, ablative materials for rocket and military, and recycling. Other newer materials discussed include click-based dual curing thermosets, benzoxazine resins, polyphthalonitrile resins, and environmentally friendly bio-based epoxies and composites.

Some of the applications, especially the electrical application section, were focused on a single topic (PCB) and did not do justice to the many essentially electrical applications thermoset material provide to very traditional electrical products (i.e., contactors, fuses, circuit breakers, switchgear, among many others). Also, much of the focus is on epoxy-based thermosets. Very little information is provided on other types of thermoset materials including polyester.

Undergraduates, graduates who want to learn about the thermoset material structure and how structure and processing affects material properties, and working professionals could use this book as a concise reference source to help specify materials, provided that the materials of interest are covered in this book.

Current Signature Analysis for Condition Monitoring of Cage Induction Motors—Industrial Application and Case Histories

W. T. Thomson and I. Culbert
IEEE Press
John Wiley & Sons Inc.
111 River Street
Hoboken, NJ 07030
Phone: (877) 762-2974
Fax: (800) 597-3299
http://www.wiley.com
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Motors are used in many critical as well as noncritical applications, especially in industry. Approximately 40 to 50% of the total generated electricity in an industrialized country is consumed by induction motors. Failure of a motor can be very costly because of motor repair or replacement and, more so, because of the unplanned downtime for critical processes at paper mills, chemical processing plants, oil refineries, and many other places. These industries can lose millions of
dollars in revenue due to an unexpected motor failure.

Methods for monitoring motor condition or “health” in real time can provide a very useful predictor of failures, and, given sufficient warning, the operator can plan accordingly. One such method of monitoring motor health is by measuring motor current. By analyzing changes in the current signature, a skilled operator or advanced algorithm may be able to detect an impending failure. This method is called motor current signature analysis (MCSA).

This book, presenting 50 case studies of industrial squirrel cage induction motors [SCIM; rated 127 kW (170 HP) to 10,000 kW (13,340 HP)], exclusively uses MCSA to monitor motor health. A diagnosis of the problem and a detailed teardown of the motor with photographs to document the diagnosis also accompany the current signatures. An important aspect of this book is that these are actual case studies from motors used in actual industrial applications, unlike the majority of available MCSA data reported in literature, which are controlled laboratory-based studies. Thus, there are case studies presented that produced false positives, meaning that the current signature analysis method did not correctly predict a failure.

The book begins by presenting essential background information to the reader that ensures they fully understand the operation and design of SCIM, including an appreciation for the design, construction, and manufacture of cage rotors; the causes of breaks in cage windings; and the fundamentals of the use of MCSA to detect broken rotor bars. The book continues with case histories on MCSA used to assess the operational condition of different designs of cage windings when SCIM are driving steady mechanical loads. Challenges of using MCSA are revealed when it is used to diagnose broken rotor bars when cylindrical disturbances from mechanical loads are reflected back into the motor. Similar challenges are shown with a false positive result due to reflected mechanical dynamics from the combination of low-speed gearboxes and fluctuating loads from conveyors and crushers. Other false positives include effects from worn belts in belt-driven cooling fans and the detection of imperfections in the casing of a submersible seawater lift pump. Other, successful and unsuccessful, cases presented show the effects of air gap eccentricity resulting in unbalanced pull that can cause stator to rotor rubbing. Other topics cover the reasons why end users have not been receptive to the application of MCSA to diagnose shorted turns in LV or HV stator windings or faults in roller elements bearings in SCIM. There is also a flow chart on the application of MCSA for practical use.

This book can be a very useful resource for those who have to either maintain or diagnose SCIM. It is focused on case studies from bearing failures, stator winding failures, broken rotor bars or end rings in cage induction motors, high air gap eccentricity and unbalanced magnetic pull. The best aspect of the book is the great detail that the authors present when describing each case study.

Printable Solar Cells
N. D. Sankir and M. Sankir
John Wiley & Sons Inc.
111 River Street
Hoboken, NJ 07030
Phone: (877) 762-2974
Fax: (800) 597-3299
http://www.wiley.com
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Solar cells (photovoltaic cells) provide energy conversion from sunlight to electricity by means of the photovoltaic effect. With efficient and low-cost light-to-energy conversion, this process can provide the energy needed to power the world. However, new materials and manufacturing techniques are the key for increasing efficiency and reducing costs of photovoltaic (PV) cells.

This book focuses on materials and manufacturing techniques for solar cell applications. The book is organized into four parts. Part I covers organic and inorganic hybrid materials and solar cell manufacturing methods. Descriptions of operational principles and types of hybrid solar cells, physical and chemical principles of film formation by solution processes, polymer quantum dot hybrid cells, hole transporting layers, and solution processing techniques are described.

Part II details organic materials and processing technologies. Details of spray-coating technologies and the organic materials used in these methods are described. Interfacial effects, critical to organic solar cells, to improve device performance and decrease the cost of printable solar cells is described. Also detailed are the structural, optical, electrical, and electronic properties of thin film poly (3,4-ethylendioxythiophene): polystyrene sulfonate (PEDOT:PSS), the most commonly used organic material for printable solar cell applications.

Part III describes perovskite solar cells; perovskite is a new and promising material for printable PV applications. An inkjet printing process based on nano-composite materials is also described.

Part IV covers inorganic materials and processing technologies for printable solar cells. Structural, optical, and electrical properties of kesterites, device architecture, and deposition methods are covered. Inorganic hole transport materials for transition metal-oxide perovskite cells, including Cu$_2$O, CuSCN, CuInS$_2$, and CuZnSnS$_4$, are described as well as electrode materials.

This book provides a comprehensive view of new and very promising materials and fabrication methods for printable solar cell applications. With material properties; manufacturing methods; PV performance relationship of organic, inorganic, and hybrid structures described in this book, readers working in the fields of PV cell development will be able to use this book to understand the effect that new materials and manufacturing methods may have on the next generation of solar cells.

Black TiO$_2$ Nanomaterials for Energy Applications
X. Chen and Y. Cui, Editors
World Scientific Publishing Co.
5 Toh Tuck Link
Singapore 596224
US Office:
27 Warren Street, Suite 401-402
Hackensack, NJ 07601
Titanium dioxide (TiO$_2$) is naturally white in color and has been primarily used as the base for white paint, that is, until the discovery of black TiO$_2$. Properties of nanoscale black TiO$_2$ make it particularly interesting for energy applications, in particular charge storage, batteries, and electrochemical water splitting applications.

This book describes the synthesis and properties of black TiO$_2$ and several applications. It begins with the method first used to obtain black TiO$_2$, a high-pressure hydrogenation method. It includes details on the electronic and optical properties of black TiO$_2$ as well as more cost-effective synthesis methods to produce black TiO$_2$ including electrochemical and mechanical methods. Structural properties are described for nanowires, nanotube arrays, thin films, and mesoporous structures made from black TiO$_2$. Performance measures are given for uses of black TiO$_2$ for photocatalysts, photothermal applications, rechargeable batteries, and supercapacitors. Band structure and factors affecting the electronic band structure are also discussed.

Applications that exploit the unique properties of black TiO$_2$ cover nanowires for charge storage and photochemical driven water splitting, lithium-ion batteries, and lithium-sulfur batteries.

This book not only provides a fundamental technical background on black TiO$_2$ and the synthesis of this material, it also covers state-of-the-art applications and will provide the reader with current information on property behavior and show the direction of the latest research for this interesting material for energy applications.