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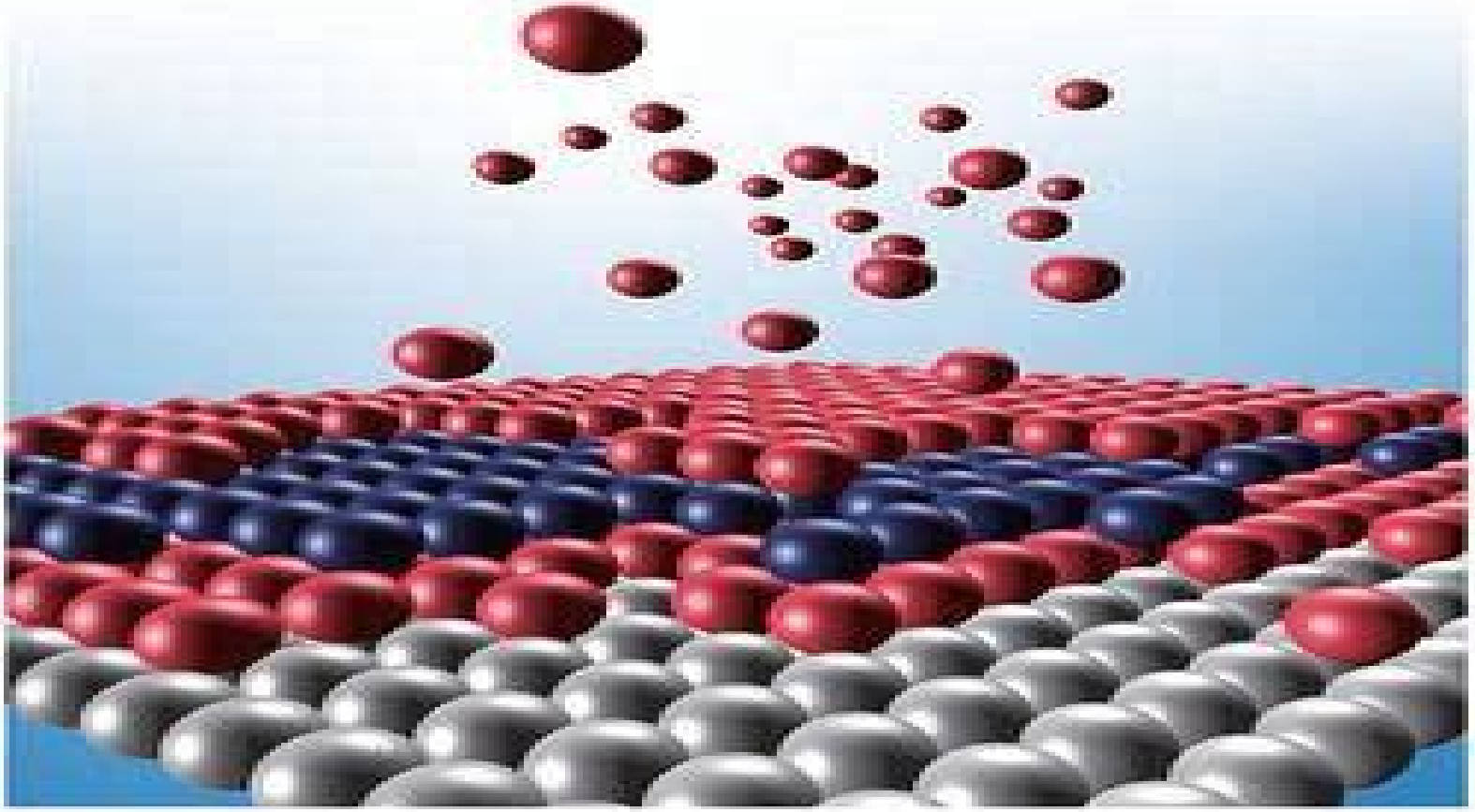
Atomic Layer Deposition of Nanostructured Materials



Atomic Layer Deposition Of Nanostructured Materials

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Atomic Layer Deposition Of Nanostructured Materials:

Atomic Layer Deposition of Nanostructured Materials Nicola Pinna,Mato Knez,2012-09-19 Atomic layer deposition formerly called atomic layer epitaxy was developed in the 1970s to meet the needs of producing high quality large area fl at displays with perfect structure and process controllability Nowadays creating nanomaterials and producing nanostructures with structural perfection is an important goal for many applications in nanotechnology As ALD is one of the important techniques which offers good control over the surface structures created it is more and more in the focus of scientists The book is structured in such a way to fi t both the need of the expert reader due to the systematic presentation of the results at the forefront of the technique and their applications and the ones of students and newcomers to the fi eld through the first part detailing the basic aspects of the technique This book is a must have for all Materials Scientists Surface Chemists Physicists and Scientists in the Semiconductor Industry *Atomic Layer Deposition Prepared Nanostructured Materials for Various Catalytic Reactions* Xiaofeng Wang (Chemical engineering graduate),2018 Atomic layer deposition ALD has been widely used for thin film coating and metal nanoparticles NPs preparation In this report the applications of ALD prepared nanostructured materials in catalysis were examined Highly dispersed Pt monometallic catalysts with different substrates and multi walled carbon nanotubes MWCNTs supported Pt Co bimetallic catalysts were synthesized by ALD for selective hydrogenation of alpha beta unsaturated aldehydes to unsaturated alcohols UA Pt MWCNTs showed the highest selectivity of UA in selective hydrogenation of citral as compared to Pt SiO2 Pt ALD Al2O3 and Pt gamma Al2O3 After adding Co the highest selectivity was achieved with high conversion in hydrogenation of both cinnamaldehyde and citral over an optimized Pt Co MWCNTs catalyst Highly dispersed Pt Co MWCNTs bimetallic catalysts were also used for hydrogenolysis of 5 hydroxymethylfurfural HMF to 2 5 dimethylfuran DMF reaction High yield of DMF 90% was achieved in hydrogenolysis of HMF over an optimized Pt Co MWCNTs catalyst after 8 hr of reaction time under mild conditions Fe NPs and single atoms were deposited on various substrates via ALD Fe SiO2 NPs showed a high activity in CO oxidation reaction with a long term stability at high temperature The TiO2 NPs deposited with Fe single atoms showed the highest activity and had an up to six fold photocatalytic activity enhancement over pure TiO2 CeO2 ALD and ZrO2 ALD were also applied on TiO2 to boost the photocatalytic activity of TiO2 and both two methods improved the photocatalytic efficiency of TiO2 significantly Abstract page iv **Advances in Thin Films, Nanostructured Materials, and Coatings** Alexander D. Pogrebnjak,Valentine Novosad,2019-02-08 This book highlights the latest advances in chemical and physical methods for thin film deposition and surface engineering including ion and plasma assisted processes focusing on explaining the synthesis processing structure properties relationship for a variety of thin film systems It covers topics such as advances in thin film synthesis new thin film materials diamond like films granular alloys high entropy alloys oxynitrides and intermetallic compounds ultra hard wear and oxidation resistant and multifunctional coatings superconducting magnetic semiconducting and dielectric films

electrochemical and electroless depositions thin film characterization and instrumentation and industrial applications

Nanostructured Materials for Energy Applications Abdullah M. Al-Enizi,Mohd Ubaidullah,Mohd Shkir,Abhay Kumar Singh,2025-11-13 This book demonstrates the necessity of novel methods for the development of nano structured energy materials with improved characteristics for real life applications It explores the prospective of nanoscale science to design and build device technology through novel nanoscale photodetectors photoconductors photovoltaics solar cells batteries supercapacitors fuel cells hydrogen generation and storage and so forth Various kinds of organic inorganic and organic inorganic multilayer thin film photovoltaic solar cell devices are also addressed Features Discusses nanotechnology for the development of energetic nanostructured materials and their device applications Combines all three types of nanostructured materials organic inorganic and perovskite and explores their applications at the device level Articulates kinds of preparation methods for advanced energy related nano materials and their functionalization for a variety of devices Explores the consequence of economizing and combination of 0D 1D and 2D nanomaterials to meet the future energy demand Establishes the wide range of applications of energetic nanomaterials in photovoltaics including organic and inorganic This book is aimed at graduate students and researchers in photovoltaics batteries and energy storage and thermoelectrics **New Uses of Micro and Nanomaterials** Marcelo Rubén Pagnola,Jairo Useche Vivero,Andres Guillermo Marrugo,2018-10-10 A fundamental part of modern technology is composed of devices that use special materials as main components Since the last few decades of the last century and even more recently a remarkable development has been achieved in new micro and nanostructured materials with compositional structures and production methods that open unprecedented technological economic and ecological perspectives due to high yields economies of scale the possibility of reducing weight and size and the low environmental impact of the equipment that contains them This book offers a collection of excellent studies that use state of the art methodologies developed by professional researchers from different countries in diverse areas of materials In this way this book is particularly useful to academics scientists practicing researchers and postgraduate students whose work relates to the latest nanomaterial technologies **Growth and Transport in Nanostructured Materials** Angel Yanguas-Gil,2016-11-30 This book will address the application of gas phase thin film methods including techniques such as evaporation sputtering CVD and ALD to the synthesis of materials on nanostructured and high aspect ratio high surface area materials We have chosen to introduce these topics and the different application fields from a chronological perspective we start with the early concepts of step coverage and later conformality in semiconductor manufacturing and how later on the range of application branched out to include others such as energy storage catalysis and more broadly nanomaterials synthesis The book will describe the ballistic and continuum descriptions of gas transport on nanostructured materials and then will move on to incorporate the impact of precursor surface interaction We will finally conclude approaching the subjects of feature shape evolution and the connection between nano and reactor scales and will briefly present different

advanced algorithms that can be used to effectively compute particle transport in some cases borrowing from other disciplines such as radiative heat transfer The book gathers in a single place information scattered over thirty years of scientific research including the most recent results in the field of Atomic Layer Deposition Besides a mathematical description of the fundamentals of thin film growth in nanostructured materials it includes analytic expressions and plots that can be used to predict the growth using gas phase synthesis methods in a number of ideal approximations The focus on the fundamental aspects over particular processes will broaden the appeal and the shelf lifetime of this book The reader of this book will gain a thorough understanding on the coating of high surface area and nanostructured materials using gas phase thin film deposition methods including the limitations of each technique Those coming from the theoretical side will gain the knowledge required to model the growth process while those readers more interested in the process development will gain the theoretical understanding will be useful for process optimization 21st Century Nanostructured Materials Phuong Pham,2022-04-20 Nanostructured materials NMs are attracting interest as low dimensional materials in the high tech era of the 21st century Recently nanomaterials have experienced breakthroughs in synthesis and industrial and biomedical applications This book presents recent achievements related to NMs such as graphene carbon nanotubes plasmonic materials metal nanowires metal oxides nanoparticles metamaterials nanofibers and nanocomposites along with their physical and chemical aspects Additionally the book discusses the potential uses of these nanomaterials in photodetectors transistors quantum technology chemical sensors energy storage silk fibroin composites drug delivery tissue engineering and sustainable agriculture and environmental applications Nanostructured Materials Prepared by Atomic Layer Deposition for Catalysis and Lithium-ion Battery Applications Rajankumar L Patel,2016 Atomic molecular layer deposition ALD MLD has emerged as an important technique for depositing thin films in both scientific research and industrial applications In this dissertation ALD MLD was used to create novel nanostructures for two different applications catalysis and lithium ion batteries MLD was used to prepare ultra thin dense hybrid organic inorganic polymer films Oxidizing the hybrid films removed the organic components and produced the desired nanoporous films Both porous alumina and titania films can be prepared by such a way A novel nanostructured catalyst Pt SiO2 with an ultra thin porous alumina shell obtained from the thermal decomposition of an aluminium alkoxide film deposited by MLD for size selective reactions was developed The molecular sieving capability of the porous metal oxide films was verified by examining the liquid phase hydrogenation of n hexene versus cis cyclooctene For lithium ion battery cathodes two different approaches are presented Firstly ultrathin and highly conformal conductive CeO2 films were coated on LiMn2O4 particles using ALD process The initial capacity of the 3 nm CeO2 coated sample showed 24% increment compared to the capacity of the uncoated one and 96% and 95% of the initial capacity was retained after 1 000 cycles with 1C rate at room temperature RT and 55 C respectively The study of ionic and electronic conductivities of the coated and uncoated materials helped explain the improved performance of CeO2 coated

materials Secondly iron oxide films were deposited using ALD on LiMn sub 1 5 Ni sub 0 5 O4 particles for the synergetic effect of performance enhancing by iron doping and conformal iron oxide film coating With an optimal film thickness of 0 6 nm the initial capacity improved by 25% at RT and by 26% at 55 C at 1C cycling rate The synergy of doping of LiMn sub 1 5 Ni sub 0 5 O4 with Fe near surface combined with the conductive and protective nature of the optimal iron oxide film led to high capacity retention 93% at RT and 91% at 55 C even after 1 000 cycles at 1C cycling rate Abstract page iv Advanced Synchrotron Radiation Techniques for Nanostructured Materials Chiara Battocchio ,2019-10-29 Nanostructured materials exploit physical phenomena and mechanisms that cannot be derived by simply scaling down the associated bulk structures and phenomena furthermore new quantum effects come into play in nanosystems The exploitation of these emerging nanoscale interactions prompts the innovative design of nanomaterials Understanding the behavior of materials on all length scales from the nanostructure up to the macroscopic response is a critical challenge for materials science Modern analytical technologies based on synchrotron radiation SR allow for the non destructive investigation of the chemical electronic and magnetic structure of materials in any environment SR facilities have developed revolutionary new ideas and experimental setups for characterizing nanomaterials involving spectroscopy diffraction scatterings microscopy tomography and all kinds of highly sophisticated combinations of such investigation techniques This book is a collection of contributions addressing several aspects of synchrotron radiation as applied to the investigation of chemical electronic and magnetic structure of nanostructured materials The results reported here provide not only an interesting and multidisciplinary overview of the chemicophysical investigations of nanostructured materials carried out by state of the art SR induced techniques but also an exciting glance into the future perspectives of nanomaterial characterization methods **On Delveloping Novel Energy-related Nanostructured Matericals by Atomic Layer Depositon** Xiangbo Meng,2011 This thesis presents the fabrication of a series of novel nanostructured materials using atomic layer deposition ALD In contrast to traditional methods including chemical vapor deposition CVD physical vapor deposition PVD and solution based processes ALD benefits the synthesis processes of nanostructures with many unrivalled advantages such as atomic scale control low temperature excellent uniformity and conformality Depending on the employed precursors substrates and temperatures the ALD processes exhibited different characteristics In particular ALD has capabilities in fine tuning compositions and structural phases In return the synthesis and the resultant nanostructured materials show many novelties This thesis covers ALD processes of four different metal oxides including iron oxide tin oxide titanium oxide and lithium titanium oxide Four different substrates were used in the aforementioned ALD processes i e undoped carbon nanotubes CNTs nitrogen doped CNTs N CNTs porous templates of anodic aluminum oxide AAO and graphene nanosheets GNS In practice owing to their distinguished properties and structural characters the substrates contributed to various novel nanostructures including nanotubes coaxial core shell nanotubes and three dimensional 3D architectures In addition the surface chemistry of the

substrates and their interactions with ALD precursors also were considered The ALD process of iron oxide ALD Fe2O3 was the first one studied and it was fulfilled on both undoped CNTs and N CNTs by using ferrocene and oxygen as precursors It was found that N CNTs are better than undoped CNTs for the ALD Fe2O3 for they provide reactive sites directly due to their inherent properties In contrast undoped CNTs need pretreatment via covalent acid oxidation or non covalent modification to create reactive sites before the ALD Fe2O3 could proceed on their surface This work resulted in different CNT Fe2O3 core shell structures with controlled growth of crystalline Fe2O3 Another metal oxide tin dioxide SnO2 was performed using tin chloride SnCl4 and water as ALD precursors It was synthesized into different nanostructures based on NCNTs AAO and GNS The work on N CNTs disclosed that the ALD SnO2 is favored by doped nitrogen atoms but the effects of different nitrogen doping configurations vary with growth temperatures In comparison the ALD SnO2 on AAO and GNS mainly relies on hydroxyl groups A common finding from the studies is that growth temperatures influence the resultant SnO2 leading to amorphous crystalline phase or the mixtures of the aforementioned two In addition the cyclic nature of ALD contributes to controlled growth of SnO2 Based on the results from the ALD SnO2 on AAO it was concluded that the ALD SnO2 experience three different growth modes with temperature i e layer by layer layer by particle and evolutionary particles The layers are in amorphous phase while the particles are in crystalline rutile phase The aforementioned understandings on ALD SnO2 led to pure SnO2 nanotubes based on AAO CNT SnO2 core shell coaxial nanotubes and GNS based SnO2 3D architectures with controlled growth and structural phases The third metal oxide titanium dioxide TiO2 was deposited using titanium isopropoxide TTIP and water as ALD precursors It was found that the ALD TiO2 is tunable from amorphous to crystalline anatase phase with temperature while the resultant deposition is controllable from nanoparticles to nanofilms as well Based on different substrate i e AAO acid pretreated CNTs and GNS TiO2 was fabricated with different nanostructures including nanotubes core shell coaxial nanotubes and 3D architectures In particular the resultant nanostructures are distinguished with controlled phases and morphologies of TiO2 Different from the above binary metal oxides the last metal oxide lithium titanium oxide Li4Ti5O12 LTO is a ternary compound The route for ALD LTO is based on combining and tuning two sub ALD systems One sub ALD system is for TiO2 using TTIP and water and another sub ALD system is for lithium containing films using lithium tert butoxide LTB and water as precursors It was revealed that through suitably matching the ratios of the two sub ALD systems and annealing the resultant films LTO is successfully synthesized on N CNTs However this pioneering work shows a bit rutile TiO2 with LTO and thus further effort is needed in future work *Fabrication and Application of Nanomaterials* S. Bandyopadhyay,2019-06-07 Publisher s Note Products purchased from Third Party sellers are not guaranteed by the publisher for quality authenticity or access to any online entitlements included with the product Nanomaterials principles practices and fabrication methodsThis advanced textbook offers comprehensive coverage of nanomaterials synthesis characterization and functionalization using solution based approaches Written from a chemical

engineering perspective Fabrication and Application of Nanomaterials illustrates each topic through concise theory numerical problems and recent case studies Students scientists and engineers studying nanotechnology and the application of nanomaterials should find the text a highly useful reference Coverage includes An introduction to nanomaterials Nucleation growth and synthesis of metal nanoparticles Functionalization of metal nanoparticles Synthesis of polymer based nanoparticles Functionalization and properties of hydrogels Characterization of metal nanoparticles Applications in Catalysis Drug delivery and biomedicine Water treatment and water management Energy harvesting **Electron Crystallography for Materials Research and Quantitive Characterization of Nanostructured Materials: Volume 1184** Peter Moeck,2009-10-07 The MRS Symposium Proceeding series is an internationally recognised reference suitable for researchers and practitioners Transport and Optical Properties of Nanomaterials Mahi R. Singh,Robert H. Lipson,2009-07-08 The conference was a forum to discuss recent developments in the growth and characterization of nano structured materials the synthesis of novel materials and their incorporation into devices with optical and electronic properties determined by nanoscale features and the theoretical modeling of electronic optical magnetic and thermal properties of such systems Nanostructured Materials, Thin Films and Hard Coatings for Advanced Applications Lilyana Kolakieva,Roumen Kakanakov,2010-01-26 Selected peer reviewed papers from the 2nd International Conference on Nanostructured Materials Thin Films and Hard Coatings for Advanced Applications Sozopol Bulgaria May 24 27 2009 **Novel Anti-Corrosion and Anti-Fouling Coatings and Thin Films** Hari Murthy,Vinay Jha Pillai,Kukatlapalli Pradeep Kumar,Matthew Cowan,2024-08-29 Nanomaterials and nanocomposite materials have been developed as corrosion inhibitors and are the most noble and effective alternatives to traditional organic corrosion inhibitors Nanomaterials provide reasonably high anticorrosive activity in both aqueous and solution phases A unified approach to this task is lacking however which highlights the role of all disciplines involved in the creation and use of corrosion protection coatings for metals Fouling is the process of accumulating unwanted material that is mostly non living and comprised of detritus and organic or inorganic compounds or organisms such as tiny viruses up to giant kelps This book covers both the processes of biofouling and anti bio fouling and the devices that stop the biofouling process This book provides a missing synopsis by providing an understanding of the anticorrosive and anti biofouling effects of nanomaterials and nanocomposites under different environments It features an up to date picture of the quality and chemistry of a substrate surface its proper preparation by conversion treatment the function of resins and anticorrosive pigments in paints and novel concepts for corrosion protection *Optical and Sensor Characteristics of Nanocomposites* Vinayak Adimule,Rajendrachari Shashanka,2022-10-07 Aggregated Book **Frontiers in Micro-Nano Science and Technology** Hai Lin Cong,Bing Yu,Xing Lu,2014-04-17 Selected peer reviewed papers from the 12th China International Nanoscience and Technology Symposium Chengdu 2013 and the Nano Products Exposition Sponsored by Chinese Society of Micro Nano Technology and IEEE Nanotechnology Council CINSTS 2013 October 27 31

2013 Chengdu China X-ray Characterization of Nanostructured Energy Materials by Synchrotron Radiation Mehdi Khodaei,Luca Petaccia,2017-03-22 Nowadays nanomaterials are attracting huge attentions not only from a basic research point of view but also for their potential applications Since finding the structure property processing relationships can open new windows in the application of materials the material characterizations play a crucial role in the research and development of materials science The increasing demand for energy with the necessity to find alternative renewable and sustainable energy sources leads to the rapid growth in attention to energy materials In this book the results of some outstanding researches on synchrotron based characterization of nanostructured materials related to energy applications are presented **Synthesis and Modification of Nanostructured Thin Films** Ion N. Mihailescu,2020-03-17 The Special Issue Synthesis and Modification of Nanostructured Thin Films highlights the recent progress in thin film synthesis modification and characterization New methods are reviewed for the synthesis and or modification of thin films based on laser magnetron chemical and other techniques The obtained thin nanostructures are characterized by complex and complementary techniques We think that most of proposed methods can be directly applied in production but some others still need further elaboration for long term prospective applications in lasers optics materials electronics informatics telecommunications biology medicine and probably many other domains The Guest Editor and the MDPI staff are therefore pleased to offer this Special Issue to interested readers including graduate and PhD students as well as postdoctoral researchers but also to the entire community interested in the field of nanomaterials We share the conviction that this can serve as a useful tool for updating the literature but also to aid in the conception of new production and or research programs There is plenty of room for further dedicated R D advances based on new instruments and materials under development *Ceramic Nanomaterials and Nanotechnology* ,2006

Enjoying the Melody of Term: An Psychological Symphony within **Atomic Layer Deposition Of Nanostructured Materials**

In a world eaten by displays and the ceaseless chatter of quick conversation, the melodic splendor and emotional symphony developed by the written term often diminish into the background, eclipsed by the constant noise and distractions that permeate our lives. Nevertheless, set within the pages of **Atomic Layer Deposition Of Nanostructured Materials** an enchanting fictional treasure overflowing with organic thoughts, lies an immersive symphony waiting to be embraced. Crafted by an outstanding musician of language, this charming masterpiece conducts viewers on a mental journey, skillfully unraveling the hidden songs and profound influence resonating within each carefully crafted phrase. Within the depths of the poignant assessment, we will explore the book is main harmonies, analyze their enthralling publishing model, and surrender ourselves to the profound resonance that echoes in the depths of readers souls.

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Atomic Layer Deposition Of Nanostructured Materials Introduction

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