Techniques de l'Ingénieur

LES FOCUS
TECHNIQUES DE L'INGÉNIEUR

MATÉRIAUX FONCTIONNELS ET FONCTIONNALISATION DE SURFACES

Comment améliorer le comportement en service des matériaux ?

Novembre / 2015

En collaboration avec Expernova

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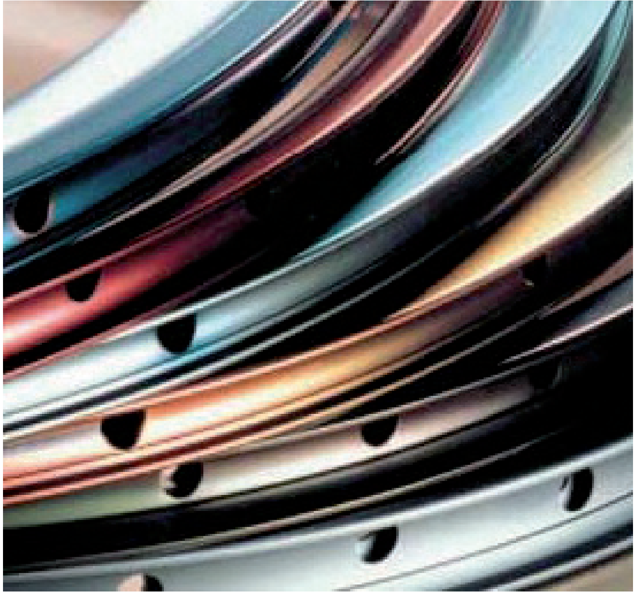
SOMMAIRE



AVANT-PROPOS

L'élaboration de nouveaux matériaux et l'étude de leurs propriétés physiques et chimiques constituent un domaine de recherche particulièrement actif, en lien avec les demandes sociétales et industrielles dans les technologies de la santé, de l'environnement et de l'information. La dynamique d'innovation dans ce domaine repose sur les avancées techniques réalisées dans l'élaboration et surtout la structuration des matériaux, sur la mise en évidence de propriétés nouvelles liées à des effets de taille (nanoparticules, par exemple) et sur la maîtrise de la fonctionnalisation de surfaces avec son corollaire, le contrôle de la stabilité de l'interface créée.

Cet aspect de **fonctionnalisation de surfaces par des films minces organiques** est absolument essentiel dans de nombreuses applications telles que les capteurs chimiques ou biochimiques, les dispositifs pour l'optoélectronique, la microélectronique, l'électronique moléculaire, la protection contre la corrosion et la « salissure » (packaging des puces microélectroniques, par exemple), la formation de films lubrifiants pour la micro- ou la nanomécanique, la formation de films biocompatibles résistants...

Le principe de base est extrêmement simple à comprendre : tout matériau interagit avec son environnement via sa surface et toutes les interactions avec cet environnement dépendent des propriétés surfaciques du matériau. Par conséquent, si l'on veut mettre à profit les phénomènes d'effets de surface, un contrôle fin de la chimie de surface est nécessaire pour pouvoir réguler les interactions du matériau avec le milieu environnant sans toutefois modifier les propriétés de structure de ce matériau. Un même matériau peut alors présenter des propriétés de surface différentes en fonction de la façon dont il a été fonctionnalisé.

Le fonctionnement, les performances et la durabilité des dispositifs intégrant ces matériaux fonctionnalisés sont conditionnés par la maîtrise de la fonctionnalisation de surface. Celle-ci requiert des connaissances et un savoir-faire relevant à la fois de la recherche fondamentale et des applications technologiques.

Ce livre blanc est composé d'un extrait de l'article *Fonctionnalisation moléculaire des surfaces par réduction de sels d'aryldiazonium* rédigé par Corinne LAGROST, Alice MATTIUZZI, Ivan JABIN, Philippe HAPIOT et Olivia REINAUD [IN165]. Retrouvez l'intégralité de l'article sur http://www.techniques-ingenieur.fr/base-documentaire/materiaux-th11/surfaces-et-structures-fonctionnelles-42534210/fonctionnalisation-moleculaire-des-surfaces-par-reduction-de-sels-d-aryldiazonium-in165/

Il comprend également une sélection d'experts scientifiques ou industriels, et de profils d'entreprises et de laboratoire de recherche, travaillant sur les matériaux fonctionnels. Ces informations sont extraites de la base de données Expernova.

FONCTIONNALISATION ORGANIQUE DES SURFACES

Différentes approches ont été développées pour former des films organiques minces (1 µm à 100 nm) ou ultraminces (10 nm à 1 nm) sur des surfaces. On peut distinguer les méthodes dites de **physisorption** qui mettent en jeu des énergies de liaison faibles entre la surface et le film organique (de l'ordre de quelques kJ · mol^{-1}) et les méthodes de **chimisorption** ou plutôt de **chimigreffage** pour lesquelles les valeurs énergétiques sont nettement plus conséquentes, de l'ordre de la centaine de kJ · mol^{-1}. L'établissement d'une liaison chimique forte entre la surface et la couche organique est forcément un atout car elle garantit une plus grande stabilité de l'interface formée et donc une plus grande robustesse des couches. On a donc tout intérêt à privilégier la voie chimigreffage dans l'optique d'une fonctionnalisation de surface robuste. Il existe deux grandes catégories de procédés de chimigreffage : les procédés chimiques et les procédés électrochimiques.

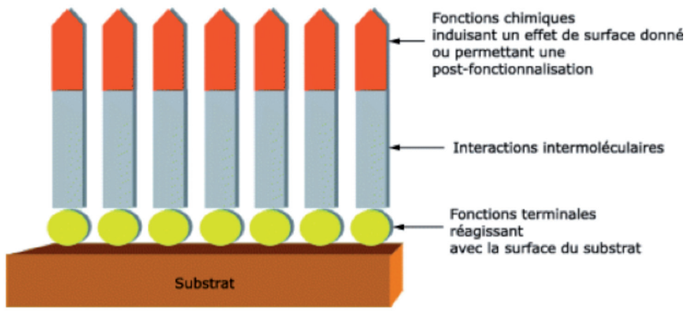


Figure 1 - Schéma d'une monocouche auto-assemblée sur un substrat

PROCÉDÉS CHIMIQUES

La surface est simplement mise en contact avec une solution contenant des molécules possédant une fonction terminale capable de réagir spontanément et très spécifiquement avec la surface (*figure 1*).

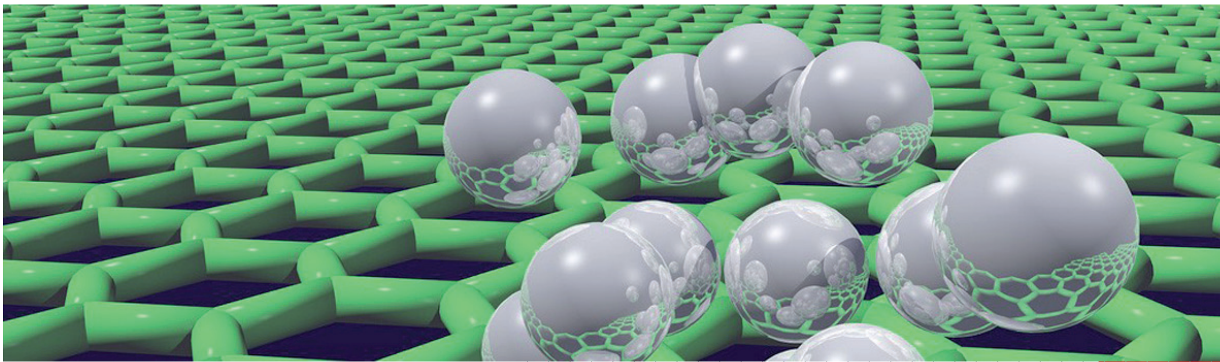
L'autre extrémité des molécules est décorée par une fonction chimique choisie pour induire un effet de surface déterminé (propriétés de mouillage, par exemple) ou bien par une fonction chimique réactive permettant d'introduire une entité fonctionnelle à partir d'un couplage chimique sur la surface (**post-fonctionnalisation**). Les entités fonctionnelles peuvent être diverses suivant l'application considérée : des nanoparticules, des protéines, des anticorps, des brins d'ADN, des molécules assurant une fonction spécifique (complexation d'ions métalliques, etc.), ou encore des molécules capables d'exécuter une fonction sous l'action de *stimuli* externes (lumière, variations de pH, application d'un potentiel électrique)...

Dans les procédés chimiques, la première étape d'adsorption est généralement très rapide. En revanche, l'autoassemblage qui suit cette étape (c'est-à-dire la formation de domaines moléculaires ordonnés) est beaucoup plus lent. Il résulte d'un équilibre subtil entre interactions surface/molécules et interactions intermoléculaires. Ainsi, il faut attendre plusieurs heures, voire plusieurs jours pour obtenir une couche compacte et bien organisée. La mise en œuvre est néanmoins facile et permet d'obtenir aisément des **monocouches** (couches ultrafines) sur la surface du matériau. Toutefois, elle nécessite généralement de cibler bien spécifiquement un couple précurseur moléculaire/surface.

Par définition, une **monocouche moléculaire** est un film organique déposé sur une surface qui est constitué d'**une seule** assise de **molécules**. Par opposition, on parle de multicouches lorsque le film organique est composé de plusieurs couches de molécules qui peuvent être régulièrement ordonnées en étages ou bien enchevêtrées.

PROCÉDÉS ÉLECTROCHIMIQUES

Ces procédés concernent des réactions électrochimiques au sens large, c'est-à-dire qui mettent en jeu un transfert d'électrons, soit hétérogène, soit homogène. Le point commun de ces méthodes est la production d'espèces radicalaires à partir du transfert d'électrons, espèces qui vont ensuite réagir pour former une liaison avec la surface. Les processus peuvent s'effectuer, soit par voie oxydante, soit par voie réductrice.



MATÉRIAUX FONCTIONNELS, QUELQUES ACTEURS

PRÉSENTATION DES PANORAMAS EXPERNOVA

Expernova propose une sélection d'experts scientifiques ou industriels. Pour chaque acteur, vous disposerez d'un **profil de compétences** mis à jour au moment de la commande, d'une sélection de travaux ciblés et d'une présentation de son réseau de partenaires.

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Une sélection de **concepts et compétences clés**

- Les **travaux scientifiques de l'expert**, ciblés sur le sujet du pack
- L'**affiliation**, c'est-à-dire l'établissement ou l'entreprise de rattachement de l'expert
- Les **brevets de l'expert** ciblés sur le sujet du pack
- Les **principaux partenaires** de l'expert (co-auteur de ses travaux)

Retrouvez ci-après un extrait des informations d'un Panorama Matériaux fonctionnels.

PROFILS D'ENTREPRISES

BASF

At BASF, we create chemistry - and have been doing so for 150 years. As the world's leading chemical company, we combine economic success with environmental protection and social responsibility. Through science and innovation we enable our customers in nearly every industry to meet the current and future needs of society.

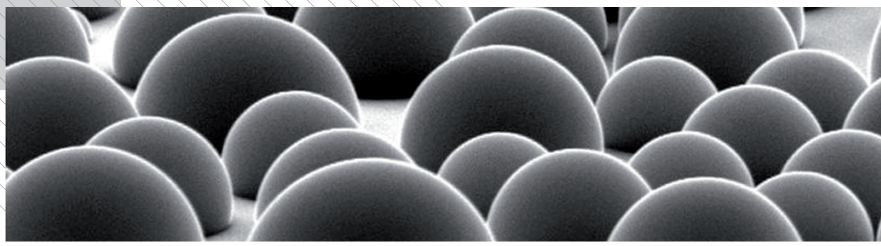
In line with our corporate purpose, around 113,000 employees contribute to the success of our customers in nearly all sectors and almost every country in the world.

Our broad portfolio ranges from chemicals, plastics, performance products and crop protection products to oil and gas. In 2014, BASF posted sales of €74.0 billion and income from operations before special items of approximately €7.6 billion. We combine economic success with environmental protection and social responsibility. Through research and innovation, we support our customers in nearly every industry in meeting the current and future needs of society. We have summed up this contribution in our corporate purpose: We create chemistry for a sustainable future.

http://www.basf.com

QUELQUES EXPERTS

- WALTER H OHRBOM
- THOMAS SUBKOWSKI
- GEORG SCHMIDT
- MATTHIAS BARTZSCH
- KASTLER MARCEL
- SILKE ANNIKA KOEHLER
- FLORIAN FELIX



QUELQUES PUBLICATIONS SCIENTIFIQUES

• BIOINSPIRED DEPOSITION OF TIO2 THIN FILMS INDUCED BY HYDROPHOBINS

Date de publication : 2010

The deposition of ceramic thin films from aqueous solutions at low temperature using biopolymers as templates has attracted much attention due to economic and environmental benefits. Titanium dioxide is one of the most attractive functional materials and shows a wide range of applications across vastly different areas because of its unique chemical, optical, and electrical properties. In the present work, we deposited smooth, nanocrystalline titania thin films by an aqueous deposition method on surface active and amphipathic proteins of fungal origin called hydrophobins. Initially, the hydrophobin molecules were self-assembled on a silicon substrate and characterized by angle-resolved X-ray photoelectron spectroscopy (AR-XPS), atomic force microscopy (AFM) and surface potential measurements. Thin films of titanium dioxide were deposited on the surface of hydrophobin self-assembled monolayers from aqueous titanium(IV) bis(ammonium lactate) dihydroxide solution at near-ambient conditions. The microstructure of the as-deposited films was analyzed by AFM, scanning and transmission electron microscopy, which revealed the presence of nanocrystals. The titania films were also characterized using AR-XPS and Fourier transform infrared spectroscopic (FTIR) techniques. Appropriate mechanisms involved in film deposition are suggested. Additionally, nanoindentation tests on as deposited titania films showed their high resistance against mechanical stress.

Auteurs : Lars P. H. Jeurgens, D. Santhiya, C. Greiner, Z. Burghard, J. Bill, Thomas Subkowski

• BIOINSPIRED DEPOSITION OF TIO2 THIN FILMS INDUCED BY HYDROPHOBINS

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Auteurs : Lars P. H. Jeurgens, D. Santhiya, C. Greiner, Z. Burghard, J. Bill, Thomas Subkowski

QUELQUES BREVETS

• AMPHIPHILIC PROTEIN IN PRINTED ELECTRONICS

Disclosed is a method for preparing an organic electronic device, which contains one or more layers of a suitable functional material on a substrate, which process is characterized in that at least one interlayer of an amphiphilic protein is placed between adjacent layers of the functional material, or between the substrate and the adjacent layer of the functional material. The protein interlayer improves the adhesion of layers without negative impact on the device's performance.

Dates : 2012-2013

Référence : EP 2599139 A1

Auteurs : SILKE KOEHLER,MARCEL KASTLER, Georg Schmidt, Matthias BARTZSCH

- METHOD OF MAKING CARBAMATE FUNCTIONAL MATERIALS

A method of preparing a coating composition comprises reacting a first material having a group or an ester of a low-boiling alcohol with a compound having a carbamate group and a hydroxyl group, wherein the reaction is catalyzed by an enzyme, to form a carbamate-functional material and then combining the carbamate-functional material with a crosslinker having carbamate-reactive groups in a coating composition.

Dates : 2009-2011

Référence : US 2009074978 A1

Auteur : WALTER H OHRBOM

MERK

Merck is a global pharmaceutical and chemical company with a history that began in 1668, and a future shaped by around 40,000 employees in 67 countries.

The operational business is managed under the umbrella of Merck KGaA headquartered in Darmstadt (Germany). Around 30% of the company's total capital is publicly traded, while the Merck family owns an interest of about 70% via the general partner E. Merck KG.

Merck is the world's oldest pharmaceutical and chemical company. Its roots date back to 1668. In 1917 the U.S. subsidiary Merck & Co. was expropriated and has been an independent company ever since.

Innovation - at Merck this is not just a buzzword. We spend more than 1 billion every year to serve the well-being of many people and to address social issues while at the same forming the basis for further business success.

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Merck ensures that its employees find the best prerequisites for this. We continuously expand our research capabilities through acquisitions, partnerships and strategic alliances across the borders of industries and countries.

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Research and development of innovative drugs and chemicals is crucial to long-term success. The focus of our research in Pharmaceuticals is on the development of new therapies for cancer, treatments for neurodegenerative diseases such as multiple sclerosis as well as rheumatological diseases. The focus of our research in Chemicals is on further expanding our competitive edge in liquid crystals and effect pigments.

http://www.merckgroup.com

QUELQUES EXPERTS

- PHILIPP STOESSEL
- AMIR HOSSAIN PARHAM
- JUNYOU PAN
- SPREITZER HUBERT
- HORST VESTWEBBER
- STOESSEL PHILIPP
- ROCCO FORTTE

QUELQUES BREVETS

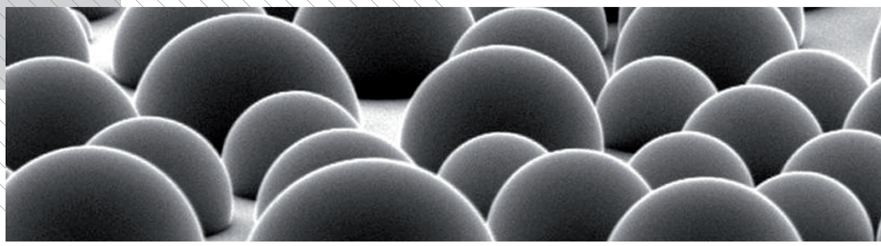
- ORGANIC IONIC FUNCTIONAL MATERIALS

The present invention relates to a novel non-polymeric organic ionic compound comprising one ion having a functional organic group, such as a matrix group, a hole injection group, a hole transport group, an electron injection group and an electron transport group, and comprising another ion preferably being so small that it may act as a mobile ion in films containing the organic ionic compound. Furthermore, the present invention relates to a composition containing the novel organic ionic compound and another functional compound. The novel organic ionic compound or the composition may be used in organic devices as functional materials, such as matrix materials or for materials charge transport. The resulting organic devices are also object of the present invention.

Dates : 2012-2014

Référence : EP 2688646 A1

Auteurs : Junyou Pan,AMIR HOSSAIN PARHAM



• FUNCTIONAL MATERIAL FOR PRINTED ELECTRONIC COMPONENTS

The invention relates to a printable precursor comprising an organometallic zinc complex which contains at least one ligand from the class of the oximates and is free from alkali metals and alkaline-earth metals, for electronic components and to a preparation process. The invention furthermore relates to corresponding printed electronic components, preferably field-effect transistors.

Dates : 2009-2013

Référence : US 8367461 B2

Auteurs : RALF KUEGLER,JOERG SCHNEIDER,RUDOLF HOFFMANN

• FORMULATIONS COMPRISING PHASE-SEPARATED FUNCTIONAL MATERIALS

The invention relates, inter alia, to formulations comprising functional materials in both the continuous and discontinuous phase, to their preparing and use in opto-electronic devices.

Dates : 2011-2012

Référence : WO 2011076323 A1

Auteurs : JUNYOU PAN, THOMAS EBERLE

PROFILS DE LABORATOIRES DE RECHERCHE

LAWRENCE BERKELEY NATIONAL LABORATORY

In the world of science, Lawrence Berkeley National Laboratory (Berkeley Lab) is synonymous with excellence. Thirteen scientists associated with Berkeley Lab have won the Nobel Prize. Fifty-seven Lab scientists are members of the National Academy of Sciences (NAS), one of the highest honors for a scientist in the United States. Thirteen of our scientists have won the National Medal of Science, our nation's highest award for lifetime achievement in fields of scientific research. Eighteen of our engineers have been elected to the National Academy of Engineering, and three of our scientists have been elected into the Institute of Medicine. In addition, Berkeley Lab has trained thousands of university science and engineering students who are advancing technological innovations across the nation and around the world.

Berkeley Lab is a member of the national laboratory system supported by the U.S. Department of Energy through its Office of Science. It is managed by the University of California (UC) and is charged with conducting unclassified research across a wide range of scientific disciplines. Located on a 200-acre site in the hills above the UC Berkeley campus that offers spectacular views of the San Francisco Bay, Berkeley Lab employs approximately 4,200 scientists, engineers, support staff and students. Its budget for 2011 is $735 million, with an additional $101 million in funding from the American Recovery and Reinvestment Act, for a total of $836 million. A recent study estimates the Laboratory's overall economic impact through direct, indirect and induced spending on the nine counties that make up the San Francisco Bay Area to be nearly $700 million annually. The Lab was also responsible for creating 5,600 jobs locally and 12,000 nationally. The overall economic impact on the national economy is estimated at $1.6 billion a year. Technologies developed at Berkeley Lab have generated billions of dollars in revenues, and thousands of jobs. Savings as a result of Berkeley Lab developments in lighting and windows, and other energy-efficient technologies, have also been in the billions of dollars.

Berkeley Lab was founded in 1931 by Ernest Orlando Lawrence, a UC Berkeley physicist who won the 1939 Nobel Prize in physics for his invention of the cyclotron, a circular particle accelerator that opened the door to high-energy physics. It was Lawrence's belief that scientific research is best done through teams of individuals with different fields of expertise, working together. His teamwork concept is a Berkeley Lab legacy that continues today.

http://www.lbl.gov/

QUELQUES EXPERTS

• SEUNG - WUK LEE
• WOO-JAE CHUNG
• YADONG YIN

- JIAN JIN
- JEAN M.J. FRECHET
- RAMAMOORTHY RAMESH
- YING-HAO CHU

QUELQUES PUBLICATIONS SCIENTIFIQUES

• COLLOIDAL NANOPARTICLE CLUSTERS: FUNCTIONAL MATERIALS BY DESIGN

Date de publication : 2012

Significant advances in colloidal synthesis made in the past two decades have enabled the preparation of high quality nanoparticles with well-controlled sizes, shapes, and compositions. It has recently been realized that such nanoparticles can be utilized as 'artificial atoms' for building new materials which not only combine the size- and shape-dependent properties of individual nanoparticles but also create new collective properties by taking advantage of their electromagnetic interactions. The controlled clustering of nanoparticle building blocks into defined geometric arrangements opens a new research area in materials science and as a result much interest has been paid to the creation of secondary structures of nanoparticles, either by direct solution growth or self-assembly methods. In this tutorial review, we introduce recently developed strategies for the creation and surface modification of colloidal nanoparticle clusters, demonstrate the new collective properties resulting from their secondary structures, and highlight several of their many important technological applications ranging from photonics, separation, and detection, to multimodal imaging, energy storage and transformation, and catalysis.

Auteurs : Zhenda Lu, Yadong Yin

• ORIENTED ASSEMBLY OF POLYHEDRAL PLASMONIC NANOPARTICLE CLUSTERS

Date de publication : 2013

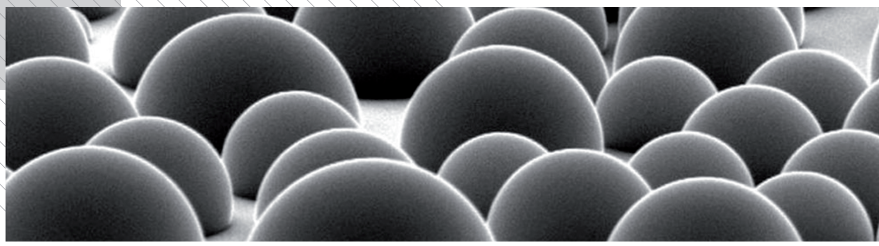
Shaped colloids can be used as nanoscale building blocks for the construction of composite, functional materials that are completely assembled from the bottom up. Assemblies of noble metal nanostructures have unique optical properties that depend on key structural features requiring precise control of both position and connectivity spanning nanometer to micrometer length scales. Identifying and optimizing structures that strongly couple to light is important for understanding the behavior of surface plasmons in small nanoparticle clusters, and can result in highly sensitive chemical and biochemical sensors using surface-enhanced Raman spectroscopy (SERS). We use experiment and simulation to examine the local surface plasmon resonances of different arrangements of Ag polyhedral clusters. High-resolution transmission electron microscopy shows that monodisperse, atomically smooth Ag polyhedra can self-assemble into uniform interparticle gaps that result in reproducible SERS enhancement factors from assembly to assembly. We introduce a large-scale, gravity-driven assembly method that can generate arbitrary nanoparticle clusters based on the size and shape of a patterned template. These templates enable the systematic examination of different cluster arrangements and provide a means of constructing scalable and reliable SERS sensors.

Auteurs : Peidong Yang, Xing Yi Ling, Joel Henzie, Sean C Andrews, Zhiyong Li

• TOWARD FUNCTIONAL NANOCOMPOSITES: TAKING THE BEST OF NANOPARTICLES, POLYMERS, AND SMALL MOLECULES

Date de publication : 2013

Nanocomposites, composed of organic and inorganic building blocks, can combine the properties from the parent constituents and generate new properties to meet current and future demands in functional materials. Recent developments in nanoparticle synthesis provide a plethora of inorganic building blocks, building the foundation for constructing hybrid nanocomposites with unlimited possibilities. The properties of nanocomposite materials depend not only on those of individual building blocks but also on their spatial organization at different length scales. Block copolymers, which microphase separate into various nanostructures, have shown their potential for organizing inorganic nanoparticles in bulk/thin films. Block copolymer-



based supramolecules further provide more versatile routes to control spatial arrangement of the nanoparticles over multiple length scales. This review provides an overview of recent efforts to control the hierarchical assemblies in block copolymer-based hybrid nanocomposites.

Auteurs : Kari Thorkelsson, Benjamin J Rancatore, Joseph Kao, Ting Xu, Peter Bai

INSTITUTE OF COLLOIDS AND INTERFACES

Research Topics :

Polymer dispersions, polyelectrolytes, amphiphilic block- and graft copolymers, colloid structures and -analytics

Hierarchical structure and mechanical adaptation of biological materials, biomimetic materials and biotemplating, structure and quality of bone material at osteoporosis and other bone diseases, application of synchrotron radiation and neutron scattering in material science

Interfaces and membranes, charged polymers and colloids, biological physics

Fluid interfaces, macromolecules at solid interfaces, thin films, microcapsules, wetting, methods development

Glycochemistry and glycobiology, vaccine development, fundamental mechanisms of infection diseases (e.g. Malaria), microreactors in organic synthesis, glycoimmunology, description of new types of colloids

http://www.mpikg.mpg.de

QUELQUES EXPERTS

- KRZYSZTOF MATYJASZEWSKI
- TAKASHI NAKANISHI
- DIRK G. KURTH
- TORSTEN K. SIEVERS
- CHARL F. J. FAUL
- ANDREAS TAUBERT
- YANFEI SHEN
- JÜRGEN HARTMANN
- PRABAL SUBEDI

QUELQUES PUBLICATIONS SCIENTIFIQUES

- OPTOELECTRONIC FUNCTIONAL MATERIALS BASED ON ALKYLATED-Π MOLECULES: SELF-ASSEMBLED ARCHITECTURES AND NONASSEMBLED LIQUIDS

Date de publication : 2013

The engineering of single molecules into higher-order hierarchical assemblies is a current research focus in molecular materials chemistry. Molecules containing π-conjugated units are an important class of building blocks because their self-assembly is not only of fundamental interest, but also the key to fabricating functional systems for organic electronic and photovoltaic applications. Functionalizing the π-cores with "alkyl chains" is a common strategy in the molecular design that can give the system desirable properties, such as good solubility in organic solvents for solution processing. Moreover, the alkylated-π system can regulate the self-assembly behavior by fine-tuning the intermolecular forces. The optimally assembled structures can then exhibit advanced functions. However, while some general rules have been revealed, a comprehensive understanding of the function played by the attached alkyl chains is still lacking, and current methodology is system-specific in many cases. Better clarification of this issue requires contributions from carefully designed libraries of alkylated-π molecular systems in both self-assembly and nonassembly materialization strategies. Here, based on recent efforts toward this goal, we show the power of the alkyl chains in controlling the self-assembly of soft molecular materials and their resulting optoelectronic properties. The design of alkylated-C₆₀ is selected from our recent research achievements, as the most attractive example of such alkylated-π systems. Some other closely related systems composed of alkyl chains and π-units are also reviewed to indicate the universality of the methodology. Finally, as a contrast to the self-assembled molecular materials, nonassembled, solvent-free, novel functional liquid materials are discussed. In doing so, a new journey toward the ultimate organic "soft" materials is introduced, based on alkylated-π molecular design.

Auteurs : Takashi Nakanishi, Jiyoung Choi, Hongguang Li

• ATRP IN THE DESIGN OF FUNCTIONAL MATERIALS FOR BIOMEDICAL APPLICATIONS

Date de publication : 2012

Auteurs : Krzysztof Matyjaszewski, Daniel J. Siegwart, Jung Kwon Oh

• NANOSTRUCTURED FUNCTIONAL MATERIALS PREPARED BY ATOM TRANSFER RADICAL POLYMERIZATION

Date de publication : 2009

Atom transfer radical polymerization (ATRP) is the most extensively studied controlled/living radical polymerization (CRP) method, with the interest originating primarily in its simplicity and broad applicability, and in the ability to prepare previously inaccessible well-defined nanostructured polymeric materials. This review illustrates the range of well-defined advanced functional materials that can be prepared by ATRP. We detail the precise synthesis of macromolecules with predetermined molecular weight, designed molecular weight distribution, controlled topology, composition and functionality. The materials include polymers with site-specific functionalities and novel architectures that are starting to find commercial application--such as stars, bottle brushes, block and gradient copolymers. This is followed by discussing their self-assembly into materials with nanoscale morphologies. These macromolecular engineering procedures provide new avenues to nanostructured functional materials for many high-value applications, for example as thermoplastic elastomers, coatings, surfactants, dispersants and as optoelectronic and biomedical materials.

Auteurs : Krzysztof Matyjaszewski, Nicolay V. Tsarevsky

Molecular recognition in functional materials at solid interfaces

Date de publication : 2008

Auteurs : Dirk G. Kurth, Torsten K. Sievers

• MOLECULAR RECOGNITION IN FUNCTIONAL MATERIALS AT SOLID INTERFACES

Date de publication : 2008

Three different aspects of molecular recognition at solid surfaces are reviewed. First, we present recent advances in the field of 2D crystallization on planar surfaces, where the surface lattice defines the orientation and recognition of molecules at the interface. Second, we review molecular recognition involved in the formation of self-assembled monolayers. Here, we also discuss molecular recognition at the interface of self-assembled monolayers and liquids. Finally, we give a short overview on molecular recognition at the surface of colloidal systems. The implication of fundamental and applied research, as well as aspects of new technologies are also discussed.

Auteurs : Dirk G. Kurth, Torsten K. Sievers, Dieter Vollhardt

POUR EN SAVOIR PLUS

- *Matériaux fonctionnels*.- Retrouvez l'intégralité de l'offre http://www.techniques-ingenieur.fr/base-documentaire/materiaux-th11/materiaux-fonctionnels-ti580/
- **Corinne LAGROST, Alice MATTIUZZI, Ivan JABIN, Philippe HAPIOT et Olivia REINAUD**.- *Fonctionnalisation moléculaire des surfaces par réduction de sels d'aryldiazonium*, [IN165] (mars 2014), http://www.techniques-ingenieur.fr/base-documentaire/materiaux-th11/surfaces-et-structures-fonctionnelles-42534210/fonctionnalisation-moleculaire-des-surfaces-par-reduction-de-sels-d-aryldiazonium-in165/
- **Cécilia MENARD-MOYON, Alberto BIANCO**.- *Atténuation de la toxicité des nanotubes de carbone grâce à la fonctionnalisation chimique* [IN167] (janvier 2014), http://www.techniques-ingenieur.fr/base-documentaire/materiaux-th11/surfaces-et-structures-fonctionnelles-42534210/attenuation-de-la-toxicite-des-nanotubes-de-carbone-grace-a-la-fonctionnalisation-chimique-in167/