

The EUChemSoc Societies have taken the significant step into the future by merging their traditional journals, to form two leading chemistry journals, the *European Journal of Inorganic Chemistry* and the *European Journal of Organic Chemistry*. Three further EUChemSoc Societies (Austria, Czech Republic and Sweden) are Associates of the two journals.

SPECIAL ISSUE

Problem-Solving with Inorganic Chemistry



Karen Hindson
Editor, *EurJIC*

Chemistry has always been an innovative discipline. The curiosity of chemists addresses questions as diverse as life itself – from how to suppress pain, to fight against disease and to master the challenges accompanying an aging population through the creative demands of fashion, sport and convenience products, the humdrum requirements of cleaning in the household and in industry, fuels for transport and other developments in everyday pursuits, to the problems of securing sufficient food for a growing population and the creation of materials for miniaturization in a computerized world.

In recent years the challenges of pollution and climate change have given Inorganic Chemistry an additional impetus to synthesise and tune the properties of materials that can, for instance, sense harmful chemicals, catalyse the decomposition of toxic substances, or provide cleaner energy, to name but a few. *EurJIC* is pleased to bring you a peek

into the exciting developments in one area of this research: metal oxide nanoparticles. The guest editors of this special issue, Nicola Pinna and Markus Niederberger, explain their concept for the issue in their editorial. I would like to thank them for the generous gift of their time in preparing this insight into the advances in the field and hope that the issue will not only be a catalyst for the ideas of those who work on these topics but also provide an interesting read for all who are interested in the potential solutions to the problems our world faces.

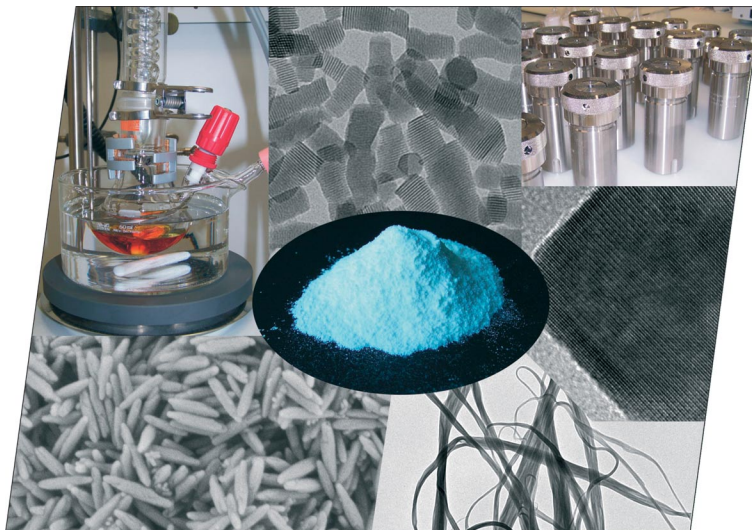
Karen J. Hindson

Dr. Karen Hindson
Editor, *EurJIC*

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COVER PICTURE

The cover picture shows a selection of metal oxide nanoparticles and metal oxide based inorganic–organic hybrid nanostructures synthesized by liquid-phase routes. Molecular precursors are typically treated with a high-boiling and coordinating solvent either in a round-bottom flask (top left) or in autoclaves (top right). The electron microscopy images show vanadium oxide nanorods (bottom left), tungsten oxide nanofibers (bottom right), samarium oxide based hybrid nanoparticles and a part of an indium oxide nanocube (right) measured at high resolution. As-obtained barium titanate nanopowder is depicted in the center of the image. The cover was designed by Markus Niederberger and Nicola Pinna, Guest Editors of this special issue.



CONFERENCE REPORT

J.-F. Hocheplid 835

Chemistry and Processes for the Design of Metal Oxide Nanoparticles

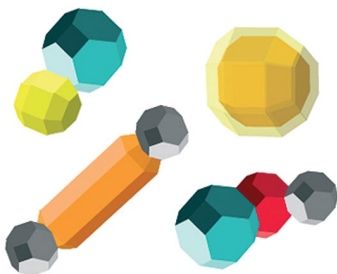
MICROREVIEW

Hybrid Nanocrystals

M. Casavola, R. Buonsanti, G. Caputo,
P. D. Cozzoli* 837–854

Colloidal Strategies for Preparing Oxide-Based Hybrid Nanocrystals

Keywords: Oxides / Nanocrystals / Colloidal synthesis / Surfactants / Topological control / Epitaxial growth / Hybrid nanomaterials



Hybrid nanocrystals (HNCs) are elaborate multifunctional nanoheterostructures, comprising size- and shape-tailored sections of different materials interconnected through inorganic junctions in defined spatial arrangements. Recent advances of colloidal chemistry approaches in the synthesis of oxide-based HNCs with topologically programmed architectures are reviewed and discussed.

SHORT COMMUNICATIONS

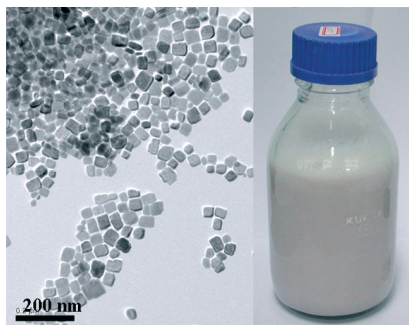
Ceria Nanoparticles

T. Yu, Y. I. Park, M.-C. Kang, J. Joo,
J. K. Park, H. Y. Won, J. J. Kim,
T. Hyeon* 855–858



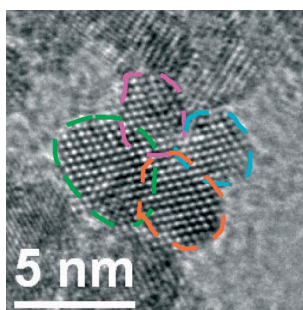
Large-Scale Synthesis of Water Dispersible Ceria Nanocrystals by a Simple Sol–Gel Process and Their Use as a Chemical Mechanical Planarization Slurry

Keywords: Ceria / Nanoparticles / Sol–gel processes / Large-scale synthesis / Chemical mechanical polishing



We report the large-scale synthesis of uniform cube-shaped ceria nanocrystals by a sol–gel reaction in air. These ceria nanocrystals are readily dispersible in aqueous media without the addition of any extra dispersing agent, and they were successfully used as a slurry for chemical mechanical polishing.

When a metal oxide sol is injected into a hot alkylamine, the condensation of the sol species is not hindered but limited to discrete spatial regions, defining the development of soluble nanocrystals, whose size is controlled by the metal concentration in the starting sol.



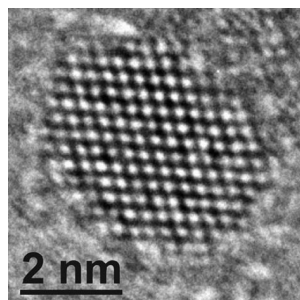
M. Epifani,* J. Arbiol, T. Andreu, J. R. Morante 859–862

Synthesis of Soluble and Size-Controlled SnO_2 and CeO_2 Nanocrystals: Application of a General Concept for the Low-Temperature, Hydrolytic Synthesis of Organically Capped Oxide Nanoparticles

Keywords: Sol–gel processes / Synthesis design / Colloids / Nanostructures

Manganese Dopants

In search for high-temperature, ferromagnetic, diluted magnetic semiconductors, manganese-doped ZrO_2 nanoparticles were synthesized by a surfactant-free nonaqueous approach. High-quality 3-nm nanocrystals with uniform size and shape and a homogeneous distribution of the magnetic ion were obtained. They showed paramagnetic behavior of the diluted spins in the matrix.



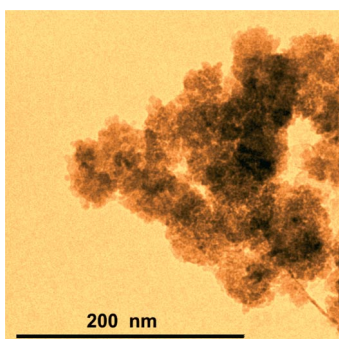
G. Clavel, M.-G. Willinger, D. Zitoun,* N. Pinna* 863–868

Manganese-Doped Zirconia Nanocrystals

Keywords: Zirconium / Manganese / Doping / Magnetic properties / Nanoparticles

ZnO Nanoparticles

The anodic behaviour of zinc was investigated in ethanol containing LiCl and water. A colloidal suspension of ZnO nanoparticles was obtained as a result of the dissolution of zinc in 0.1 M LiCl/ethanol solutions that contain H_2O . The concentration of H_2O directly influences the rate of the process and determines the size of nanoparticles.



M. Starowicz,* B. Stypula 869–872

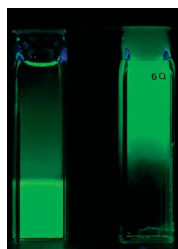
Electrochemical Synthesis of ZnO Nanoparticles

Keywords: Zinc / Nanostructures / Alcohols / Electrochemistry

FULL PAPERS

Luminescent Nanocrystals

Luminescent nanomaterials have been prepared based on a microwave-accelerated synthesis in ionic liquids. Based on the concept of synthesis, aspects of application are focused, including phase-transfer from polar to non-polar dispersants, formation of transparent thin layers as well as the realization of fully transparent dielectric barrier discharge (DBD) lamps.



A. Zharkouskaya, C. Feldmann,* K. Trampert, W. Heering, U. Lemmer 873–877

Ionic Liquid Based Approach to Luminescent $\text{LaPO}_4\text{:Ce,Tb}$ Nanocrystals: Synthesis, Characterization and Application

Keywords: Nanomaterial / Luminescence / Ionic liquid / DBD lamp

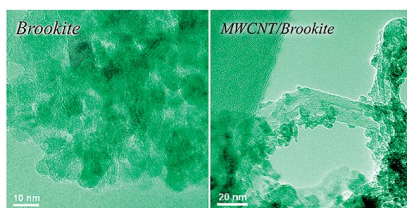
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Li Ion Batteries

D.-H. Lee, J.-G. Park, K. J. Choi,
H.-J. Choi, D.-W. Kim* 878–882

Preparation of Brookite-Type TiO_2 /Carbon Nanocomposite Electrodes for Application to Li Ion Batteries

Keywords: Lithium-ion batteries / Electrochemistry / TiO_2 / Nanostructures / Inter-calations / Conducting materials



This study examined the preparation of brookite-type TiO_2 nanoparticles by urea-mediated precipitation. Brookite was found to be an electrochemically active material, showing a strong particle size-dependent capacity. Multi-walled carbon nanotube/brookite nanocomposites were also synthesized and exhibited significantly improved capacity and cyclability.

TiO_2 Synthesis by Laser Pyrolysis

B. Pignon, H. Maskrot, V. Guyot Ferreol,
Y. Leconte, S. Coste, M. Gervais,
T. Pouget, C. Reynaud, J.-F. Tranchant,
N. Herlin-Boime* 883–889

Versatility of Laser Pyrolysis Applied to the Synthesis of TiO_2 Nanoparticles – Application to UV Attenuation

Keywords: Laser pyrolysis / TiO_2 / TiON / Nanoparticles / Nanocrystals



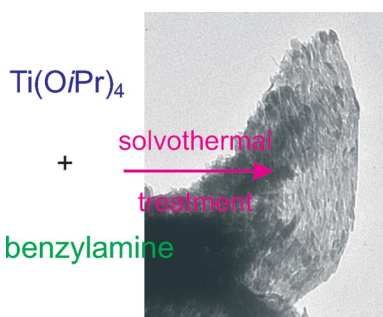
TiO_2 and TiON nanoparticles have been obtained by laser synthesis. The anatase/rutile ratio of TiO_2 nanoparticles can be controlled over the range 85:15 to 10:90, and a correlation with optical properties in the UV/Vis range is demonstrated. The presence of N as a doping element strongly improves the absorption properties of the nanoparticles.

Layered Nanostructures

G. Garnweitner,* N. Tsedev, H. Dierke,
M. Niederberger 890–895

Benzylamines as Versatile Agents for the One-Pot Synthesis and Highly Ordered Stacking of Anatase Nanoplatelets

Keywords: Nanostructures / Layered compounds / Titanium / Nonaqueous synthesis / Hybrid materials



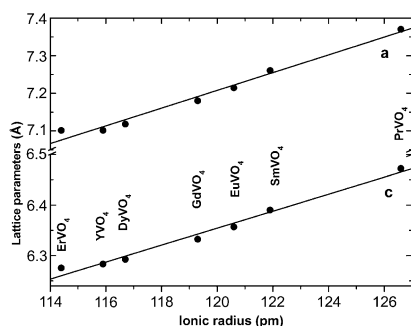
Nanocomposite structures of high ordering were obtained by a simple solvothermal treatment of titanium alkoxide in benzylamine as the solvent, without the use of any surfactants. The formed structures are shown to consist of ordered layers of anatase nanoplatelets intercalated by benzylamine. The solvent thus acts in multiple ways to provide shape control, and it also enables assembly.

Rare Earth Vanadates

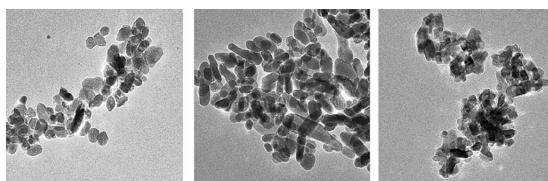
N. Deligne, V. Gonze, D. Bayot,
M. Devillers* 896–902

Yttrium, Lanthanide and Mixed Y-Ln Vanadates Prepared from Molecular Precursors Based on EDTA

Keywords: Vanadates / Lanthanides / EDTA / Molecular precursors / Mixed oxides



Zircon-type AVO_4 ($A = \text{Y}$ or Ln) materials were prepared by an alternative molecular precursor route at a moderate temperature of 800 °C and characterised by XRD, Raman and SEM. Solid solutions such as $\text{Y}_{1-x}\text{Pr}_x\text{VO}_4$ and $\text{Y}_{1-x}\text{Gd}_x\text{VO}_4$ are obtained, and linear correlations between chemical compositions and lattice parameters or Raman shifts are observed.



Sol-gel-prepared mesoporous brookite-TiO₂ thin coatings with differing initial particle size have been used to investigate solid-state dye-sensitized solar cells. An optimum conversion efficiency has been

reached ($\eta_e = 0.48\%$). Higher performances ($\eta_e = 0.74\%$) have been achieved with anatase using the same photovoltaic-device fabrication process.

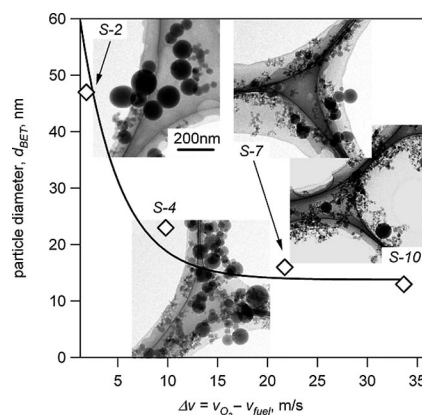
E. Lancelle-Beltran,* P. Prené, C. Boscher, P. Belleville, P. Buvat, S. Lambert, F. Guillet, C. Marcel, C. Sanchez 903–910

Solid-State Organic/Inorganic Hybrid Solar Cells Based on Poly(octylthiophene) and Dye-Sensitized Nanobrookite and Nanoanatase TiO₂ Electrodes

Keywords: Solar cells / TiO₂ nanoparticles / Brookite / Photovoltaic / DSSC

Silica Nanostructure Evolution

The tailoring of the size and morphology of SiO₂ nanoparticles in a diffusion flame (S-γ) from large but non-aggregated to small but aggregated particles was investigated. This was achieved by the introduction of flame turbulence by variation of the O₂ flow rate (γ L/min).



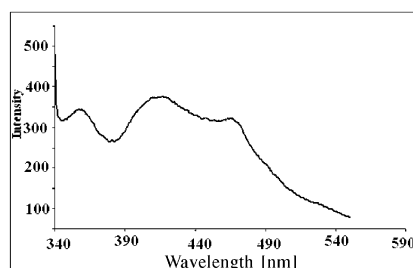
A. Camenzind, H. Schulz, A. Teleki, G. Beaucage, T. Narayanan, S. E. Pratsinis* 911–918

Nanostructure Evolution: From Aggregated to Spherical SiO₂ Particles Made in Diffusion Flames

Keywords: Nanoparticles / Silica / Diffusion flame / SAXS

Encapsulating Carbon Vesicles

The product In₂O₃@C is synthesized by the thermal decomposition of In(acetate)₃ at a relatively low reaction temperature (800 °C) in a closed Letlok reactor. This method is called the RAPET (reactions under autogenic pressure at elevated temperatures) technique.



P. P. George, A. Gedanken* 919–924

Synthesis, Characterization, and Photoluminescence Properties of In₂O₃ Nanocrystals Encapsulated by Carbon Vesicles and Neat In₂O₃ Nanocrystals Generated by the RAPET Technique

Keywords: Decomposition / Indium / Luminescence / Nanocrystals / Vesicles

Fuels for Combustion Synthesis

An alternative for the solution combustion synthesis of CaO·6Al₂O₃ was developed. A two-fuel mixture containing the most suitable fuel for each metal nitrate was used: urea for aluminium nitrate and β-alanine for calcium nitrate. In this case, the formation of pure CaO·6Al₂O₃ was achieved directly from the combustion reaction, without any additional thermal treatment.



R. Ianoș,* I. Lazău, C. Păcurariu, P. Barvinschi 925–930

Peculiarities of CaO·6Al₂O₃ Formation by using Low-Temperature Combustion Synthesis

Keywords: Combustion synthesis / X-ray diffraction / Calcium / Aluminium

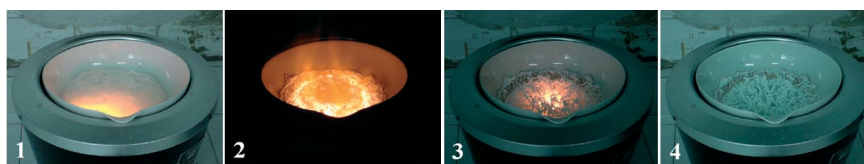
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Fuel Mixtures for Combustion Synthesis

R. Ianoş,* I. Lazău, C. Păcurariu,
P. Barvinschi 931–938

Application of New Organic Fuels in the
Direct MgAl_2O_4 Combustion Synthesis

Keywords: Combustion synthesis / X-ray
diffraction / Spinel phases / Magnesium /
Aluminium



A new alternative for the solution-combustion synthesis of MgAl_2O_4 has been developed. Instead of using a single fuel for both metal nitrates, a two-fuel mixture has been used containing the most suitable fuel for each metal nitrate: urea for aluminium

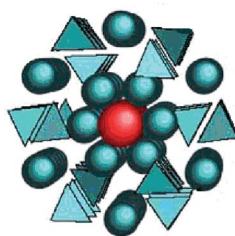
nitrate and monoethanolamine for magnesium nitrate. In this case, the formation of pure MgAl_2O_4 was achieved straight from the combustion reaction, without any additional thermal treatment.

Nanocrystalline Lanthanum Silicates

T. Kharlamova,* S. Pavlova, V. Sadykov,
M. Chaikina, T. Krieger, O. Lapina,
D. Khabibulin, A. Ishchenko, V. Zaikovskii,
C. Argiris, J. Frade 939–947

Al-Doped Apatite-Type Nanocrystalline
Lanthanum Silicates Prepared by
Mechano-chemical Synthesis: Phase, Structural and Microstructural Study

Keywords: Apatite-type silicates / Conducting materials / Doping / Mechano-chemical synthesis / Formation mechanism



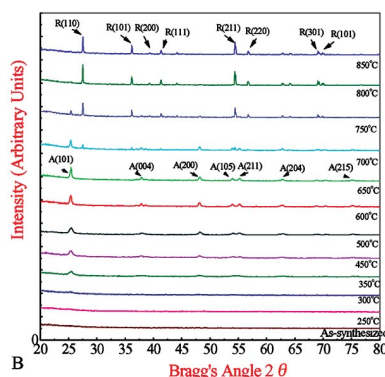
The cluster-topotactic mechanism of the formation of apatite-type lanthanum silicate by mechanochemical treatment involving hydration of the starting compounds and acid–base reactions is shown. The formation of the LaAlO_3 phase, which depends on the sample stoichiometry, suggests the existence of a biphasic domain in the $\text{La}_2\text{O}_3\text{--SiO}_2\text{--Al}_2\text{O}_3$ phase diagram at room temperature.

Codoped TiO_2 Nanoparticles

A. Ahmad,* J. A. Shah, S. Buzby,
S. I. Shah 948–953

Structural Effects of Codoping of Nb and
Sc in Titanium Dioxide Nanoparticles

Keywords: TiO_2 / Nanostructures / Sol–gel
processes / Calcination / Niobium / Scandium



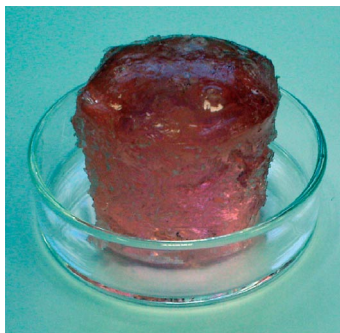
The synthesis of Nb and Sc codoped TiO_2 nanoparticles by the sol–gel technique and the changes in phase transformation of the doped samples as a function of dopant concentration and calcination temperature are reported. The valence state of Nb and Sc in the TiO_2 lattice was verified by XPS. The photodegradation of 2-chlorophenol under visible light was examined.

Fuel Cell Materials

A. Morata, A. Chesnaud, A. Tarancón,
S. Estradé, F. Peiró, J.-R. Morante,
G. Dezanneau* 954–960

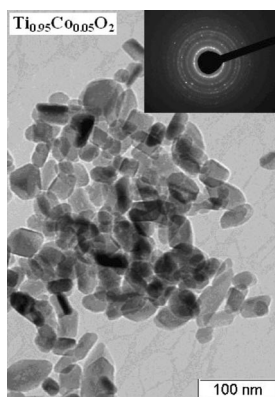
A Versatile and Low-Toxicity Route for the
Production of Electroceramic Oxide Nanopowders

Keywords: Solid oxide fuel cells / Electrolytes / Electrodes / Nanopowders / Synthesis



An alternative route to acrylamide gel polymerisation is presented for the straightforward preparation of oxide nanopowders. We prepared state-of-the-art fuel-cell materials. The synthesised powders are of nanometric crystalline size and have flake-like aggregates; pure phases are obtained at low temperature.

This paper reports on a new and swift chemical route to synthesise highly stable anatase single-phase Co- and Fe-doped TiO₂ nanoparticles, with dopant concentrations of up to 10 at.-% and mean grain sizes that range between 20 and 30 nm.



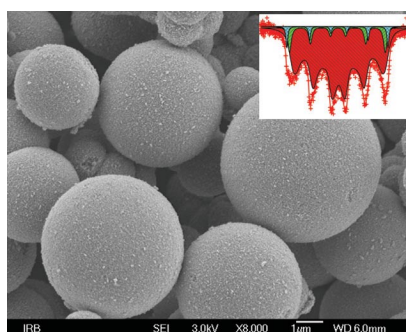
M. R. Nunes, O. C. Monteiro,
A. L. Castro, D. A. Vasconcelos,
A. J. Silvestre* 961–965

A New Chemical Route to Synthesise TM-Doped (TM = Co, Fe) TiO₂ Nanoparticles

Keywords: Diluted magnetic semiconductors / Co- and Fe-doped TiO₂ anatase nanocrystallites / Hydrothermal synthesis / TiCl₃

Nanocrystalline Iron Oxides

Treatment of iron(III) acetate in ethanol under solvothermal conditions produced nanosized magnetite particles aggregated in micrometre regular spheres. Upon the addition of acetic acid, water molecules generated in an esterification reaction participated in the hydrolysis to form exclusively nanosized hematite particles.



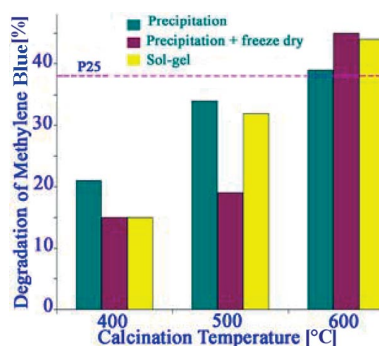
M. Gotić,* S. Musić 966–973

Synthesis of Nanocrystalline Iron Oxide Particles in the Iron(III) Acetate/Alcohol/Acetic Acid System

Keywords: Acetates / Magnetite / Hematite / Esterification / Solvothermal synthesis

Titanium Dioxide in Photocatalysis

A comparative study of TiO₂ powders prepared by precipitation and sol–gel methods along with different drying procedures was conducted. Nanocrystalline anatase was stable up to 600 °C without any pretreatment. The photocatalytic activity of TiO₂ was found to highly dependent on the calcination temperature, but independent of the synthesis and drying methods.



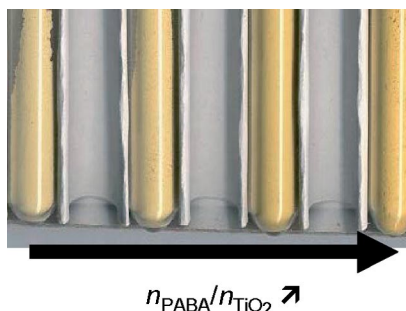
C. Junin, C. Thanachayanont,
C. Euvananont, K. Inpor,
P. Limthongkul* 974–979

Effects of Precipitation, Sol–Gel Synthesis Conditions, and Drying Methods on the Properties of Nano-TiO₂ for Photocatalysis Applications

Keywords: Titanium / Sol–gel / Precipitation / Freeze drying / Photocatalysis

Hybrid Nanoparticles

Heteroleptic titanium alkoxide was used in a one-step, simple, efficient, low-temperature (100 °C) and aqueous sol–gel synthetic method to afford crystalline amino acid surface-modified titania nanoparticles (nTiO₂/PABA). This green process allowed precise control of the organic loadings to tailor the efficacy of the nanohybrids against UVA+UVB radiations.



R. Rahal, S. Daniele,*
L. G. Hubert-Pfalzgraf, V. Guyot-Ferréol,
J.-F. Tranchant 980–987

Synthesis of *para*-Amino Benzoic Acid–TiO₂ Hybrid Nanostructures of Controlled Functionality by an Aqueous One-Step Process

Keywords: Molecular precursor / Sol–gel / Nanoparticles / Hybrids / Titanium

If not otherwise indicated in the article, papers in issue 5 were published online on January 30, 2008