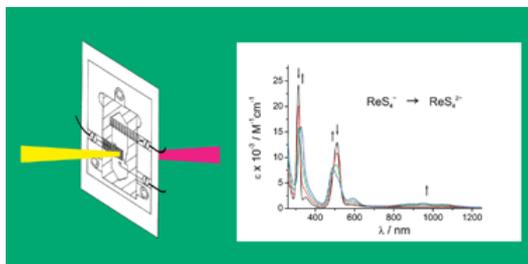


- Spectroelectrochemistry: the best of two worlds
Kaim, W.; Fiedler, J. *Chem. Soc. Rev.* **2009**, *38*, 3373 – 3382.

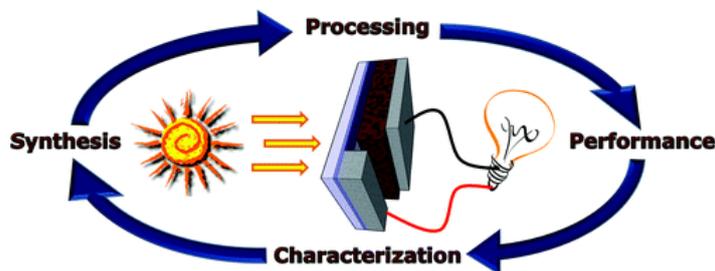
Abstract:



The combination of reaction-oriented electrochemistry with species-focused spectroscopy in spectroelectrochemistry (SEC) allows for a more complete analysis of single and multiple electron-transfer processes and redox reactions in general. Practical considerations and guidelines are provided in this *tutorial review*, and selected examples involving UV-VIS-NIR and IR absorption spectroscopy as well as electron paramagnetic resonance (EPR) are presented to illustrate the potential and the applicability of this technique.

- “Plastic” Solar Cells: Self-Assembly of Bulk Heterojunction Nanomaterials by Spontaneous Phase Separation
Peet, J.; Heeger, A. J.; Bazan, G. C. *Acc. Chem. Res.* **2009**, *42*, 1700–1708.

Abstract:



As the global demand for low-cost renewable energy sources intensifies, interest in new routes for converting solar energy to electricity is rapidly increasing. Although photovoltaic cells have been commercially available for more than 50 years, only 0.1% of the total electricity generated in the United States comes directly from sunlight. The earliest commercial solar technology remains the basis for the most prevalent devices in current use, namely, highly-ordered crystalline, inorganic solar cells, commonly referred to as silicon cells.

Another class of solar cells that has recently inspired significant academic and industrial excitement is the bulk heterojunction (BHJ) “plastic” solar cell. Research by a rapidly growing community of scientists across the globe is generating a steady stream of new insights into the fundamental physics, the materials design and synthesis, the film processing and morphology, and the device science and architecture of BHJ technology. Future progress in the fabrication of high-performance BHJ cells will depend on our ability to combine aspects of synthetic and physical chemistry, condensed matter physics, and materials science.

In this Account, we use a combination of characterization tools to tie together recent advances in BHJ morphology characterization, device photophysics, and thin-film solution processing, illustrating how to identify the limiting factors in solar cell performance. We also highlight how new processing

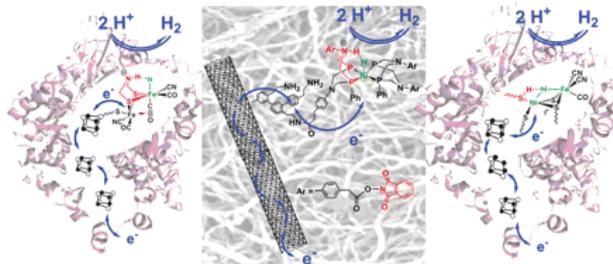
methods, which control both the BHJ phase separation and the internal order of the components, can be implemented to increase the power conversion efficiency (PCE).

The failure of many innovative materials to achieve high performance in BHJ solar cell devices has been blamed on “poor morphology” without significant characterization of either the structure of the phase-separated morphology or the nature of the charge carrier recombination. We demonstrate how properly controlling the “nanomorphology”, which is critically dependent on minute experimental details at every step, from synthesis to device construction, provides a clear path to >10% PCE BHJ cells, which can be fabricated at a fraction of the cost of conventional solar cells.

- From Hydrogenases to Noble Metal–Free Catalytic Nanomaterials for H₂ Production and Uptake

Le Goff, A.; Artero, V.; Jusselme, B.; Tran, P. D.; Guillet, N.; Métafé, R.; Fihri, A.; Palacin, S.; Fontecave, M. *Science* **2009**, *326*, 1384 – 1387.

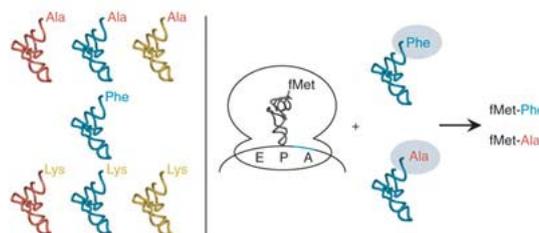
Abstract:



Interconversion of water and hydrogen in unitized regenerative fuel cells is a promising energy storage framework for smoothing out the temporal fluctuations of solar and wind power. However, replacement of presently available platinum catalysts by lower-cost and more abundant materials is a requisite for this technology to become economically viable. Here, we show that the covalent attachment of a nickel bisdiphosphine–based mimic of the active site of hydrogenase enzymes onto multiwalled carbon nanotubes results in a high–surface area cathode material with high catalytic activity under the strongly acidic conditions required in proton exchange membrane technology. Hydrogen evolves from aqueous sulfuric acid solution with very low overvoltages (20 millivolts), and the catalyst exhibits exceptional stability (more than 100,000 turnovers). The same catalyst is also very efficient for hydrogen oxidation in this environment, exhibiting current densities similar to those observed for hydrogenase-based materials.

- Natural amino acids do not require their native tRNAs for efficient selection by the ribosome
Effraim, P. R.; Wang, J.; Englander, M. T.; Avins, J.; Leyh, T. S.; Gonzalez Jr, R. L.; Cornish, V. W. *Nature Chemical Biology* **2009**, *5*, 947–953.

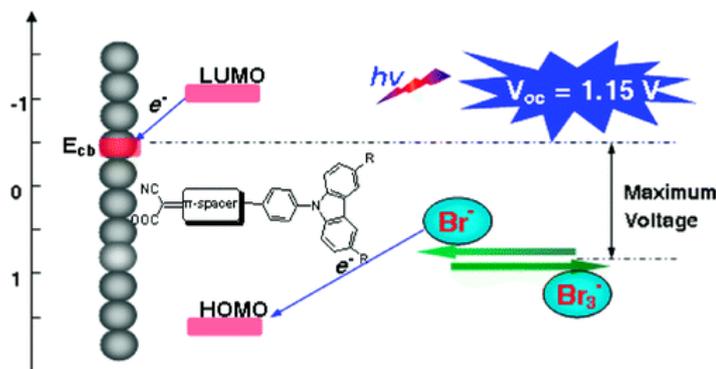
Abstract:



The involvement of tRNA structural elements beyond the anticodon in aminoacyl-tRNA (aa-tRNA) selection by the ribosome has revealed that substrate recognition is considerably more complex than originally envisioned in the adaptor hypothesis. By combining recent breakthroughs in aa-tRNA synthesis and mechanistic and structural studies of protein synthesis, we have investigated whether aa-tRNA recognition further extends to the amino acid, which would explain various translation disorders exhibited by misacylated tRNAs. Contrary to expectation, we find that natural amino acids misacylated onto natural but non-native tRNAs are selected with efficiencies very similar to those of their correctly acylated counterparts. Despite this, small but reproducible differences in selection indeed demonstrate that the translational machinery is sensitive to the amino acid-tRNA pairing. These results suggest either that the ribosome is an exquisite sensor of natural versus unnatural amino acid-tRNA pairings and/or that aa-tRNA selection is not the primary step governing the amino acid specificity of the ribosome.

- Alkynylated Aceno[2,1,3]thiadiazoles
Appleton, A. L.; Miao, S.; Brombosz, S. M.; Berger, N. J.; Barlow, S.; Marder, S. R.; Lawrence, B. M.; Hardcastle, K. I.; Bunz, U. H. F. *Org. Lett.* **2009**, *11*, 5222–5225.

Abstract:

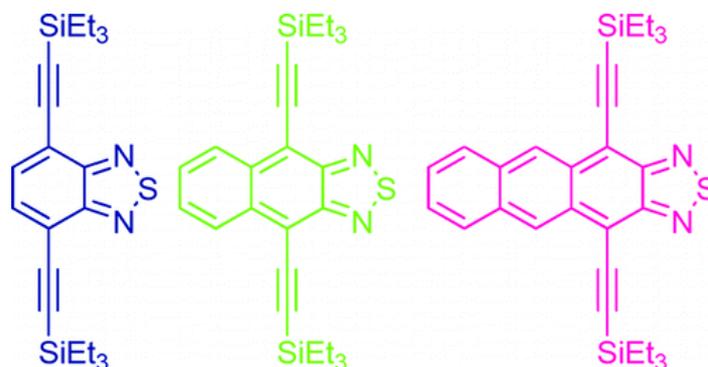


Enlarged acenothiadiazoledyes, which are easily prepared, display attractive optical and electrochemical properties. The annulation of thiadiazoledye to anthracene gives a stable material with optical properties similar to those of substituted pentacenes.

- Two Novel Carbazole Dyes for Dye-Sensitized Solar Cells with Open-Circuit Voltages up to 1 V Based on $\text{Br}^-/\text{Br}_3^-$ Electrolytes

Teng, C.; Yang, X.; Yuan, C.; Li, C.; Chen, R.; Tian, H.; Li, S.; Hagfeldt, A.; Sun, L. *Org. Lett.* **2009**, *11*, 5542–5545.

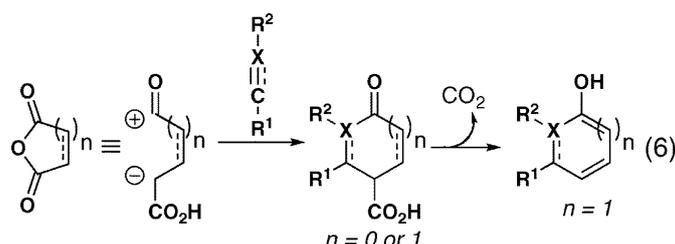
Abstract:



Dye-sensitized solar cells (DSCs) based on two novel carbazole dyes (**TC301** and **TC306**) and a $\text{Br}^-/\text{Br}_3^-$ redox mediator in dried CH_3CN solutions as electrolytes yielded a V_{oc} of 1.156 V and a η value of 3.68% and a V_{oc} of 0.939 V and a η value of 5.22% under simulated AM 1.5, respectively. The dyes **TC301** and **TC306** have more positive HOMO levels (1.59 and 1.38 V vs NHE) than the redox potential of $\text{Br}^-/\text{Br}_3^-$ -based electrolytes, which have sufficient driving force to regenerate dyes. Under similar conditions with an I^-/I_3^- instead of a $\text{Br}^-/\text{Br}_3^-$ redox mediator, DSCs sensitized by the dyes **TC301** and **TC306** produced a V_{oc} of 0.696 V and a η value of 2.36% and a V_{oc} of 0.621 V and a η value of 4.10%, respectively.

- Cyclic Anhydrides in Formal Cycloadditions and Multicomponent Reactions
González-López, M.; Shaw, J. T. *Chem. Rev.* **2009**, *109*, 164-189.

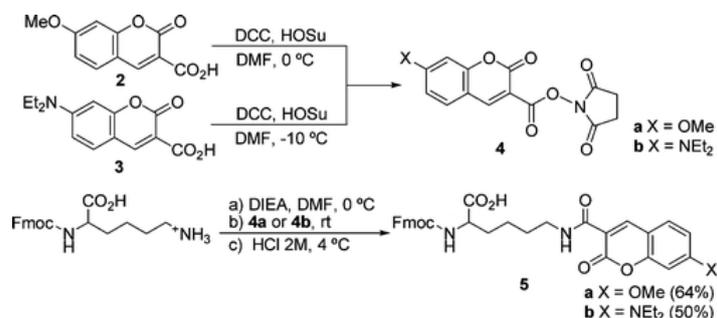
Abstract:



The reactions of cyclic anhydrides acting dually as acylating agents and C-nucleophiles in stereoselective annulation reactions provide efficient one-step synthesis of polysubstituted heterocyclic and carbocyclic molecules. The reactivity of anhydrides is historically dominated by their ability to serve as mild acylating agents. An early example of anhydrides acting as C-nucleophiles is found in the Perkin reaction, in which aliphatic anhydrides undergo aldol condensation with aldehydes in the presence of a mild base (eq 1). An early report of the reaction of homophthalic anhydride with an aldehyde (eq 2) using strong base demonstrated the ability for cyclic anhydrides to undergo annulation reactions. Castagnoli observed in 1969 that cyclic anhydrides undergo formal cycloaddition reactions with imines (eq 3) under thermal conditions. This discovery, paired with the observations of Cushman and Haimova (eq 4) in 1977 that homophthalic anhydride underwent a similar reaction at ambient temperature, formed the foundation for much of the subsequent work on this reaction. Finally, Tamura reported a related transformation in which homophthalic anhydride reacted with alkenes and alkynes to produce fused aromatic products.

- Fluorescent Labeling of Biomolecules with Organic Probes
Gonçalves, M. S. T. *Chem. Rev.* **2009**, *109*, 190-212.

Abstract:



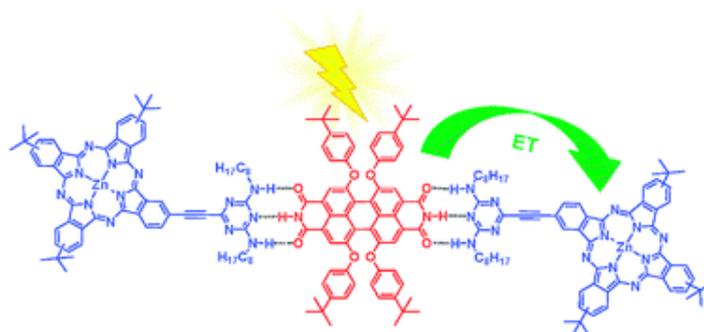
Many areas of modern technology are dependent on sensitive analytical techniques, and this is particularly true for environmental science, medicine, pharmacy, and cellular biology, where there have been many new developments in new techniques and reagents. Labeling is one of the most

common methodologies used for bioanalytical purposes, which can be carried out with radioactive materials or compounds with absorption and/or fluorescence from the ultraviolet to the near-infrared region of the electromagnetic spectrum. Use of organic molecules in nonfluorescent labeling, in the ultraviolet and visible regions, is important in several applications. However, in recent years, detection based on fluorescence techniques has received special attention and notable progress has been made in both fluorescence instrumentation and synthesis of new fluorophores. Fluorescence labeling can be extended over a wide range of wavelengths using semiconductor nanocrystals, fluorescent proteins, or organic molecules. The organic fluorophores may form covalent or noncovalent linkages with the sample to be analyzed, producing the respective conjugates or complexes that can show fluorescence from short to very long wavelengths, depending on the marker used. In addition to the intrinsic interest of new fluorophores, development of fluorophores with absorption and emission at long wavelengths is of extreme importance for biological purposes.

The main aim of this review is to provide insight into the state of the art in the field of the synthesis and application of organic fluorescent markers for labeling of amino acids, peptides, proteins, DNA, and other biomolecules. Nanocrystal semiconductors and fluorescent proteins are not discussed since recent reviews on these subjects have already been published.

- Synthesis and photophysical properties of a hydrogen-bonded phthalocyanine–perylene diimide assembly
Seitz, W.; Jiménez, A. J.; Carbonell, E.; Grimm, B.; Rodríguez-Morgade, M. S.; Guldi, D. M.; Torres, T. *Chem. Commun.* **2010**, 46, 127 – 129.

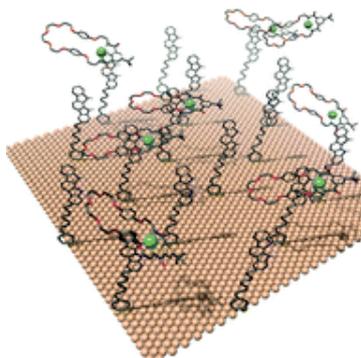
Abstract:



A supramolecular phthalocyanine–perylene diimide donor–acceptor array has been assembled by using a melamine/perylene diimide motif. Photoexcitation of the perylene diimide component affords transduction of singlet excited state energy to the energetically lower lying phthalocyanine.

- Mechanically interlocked and switchable molecules at surfaces
Davis, J. J.; Orłowski, G. A.; Rahman, H.; Beer, P. D. *Chem. Commun.* **2010**, 46, 54 – 63.

Abstract:

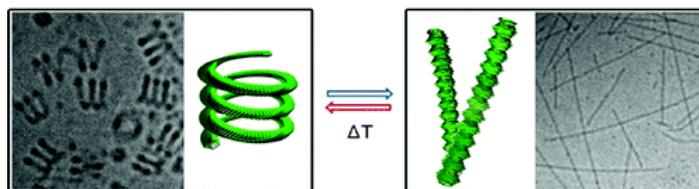


Mechanically interlocked molecules are of considerable interest from data storage, molecular scale or sensory device perspectives. Though the solution phase characterisation of these compounds has been extensively explored, progress towards real world application will, in many cases, necessitate a detailed understanding of their interfacing with supportive, optically transparent or electroactive surfaces. This feature article summarises the developments made in surface assembly and characterisation including recent progress in exploiting templating methods to interlock molecular systems on surfaces.

- Reversible Transformation of Helical Coils and Straight Rods in Cylindrical Assembly of Elliptical Macrocycles

Kim, J.-K.; Lee, E.; Kim, M.-C.; Sim, E.; Lee, M. *J. Am. Chem. Soc.* **2009**, *131*, 17768–17770.

Abstract:

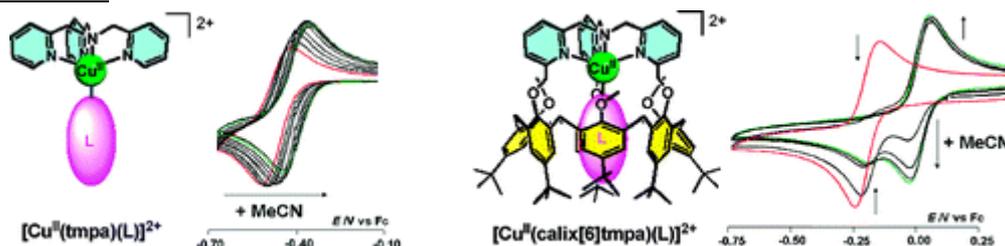


We have demonstrated that, as the molecular length of elliptical macrocycle is increased, the self-assembled structure changes from spherical micelles to helical coils and finally to monolayered vesicles, in the order of decreasing interfacial curvature. Notably, the helical coils reversibly transform into straight rods upon heating while maintaining the supramolecular chirality. This structural transition is accompanied by conformational change of the elliptical macrocycles from a boat conformation to a more planar conformation.

- Mimicking the Protein Access Channel to a Metal Center: Effect of a Funnel Complex on Dissociative versus Associative Copper Redox Chemistry

Le Poul, N.; Douziech, B.; Zeitouny, J.; Thiabaud, G.; Colas, H.; Conan, F.; Cosquer, N.; Jabin, I.; Lagrost, C.; Hapiot, P.; Reynaud, O.; Le Mest, Y. *J. Am. Chem. Soc.* **2009**, *131*, 17800–17807.

Abstract:

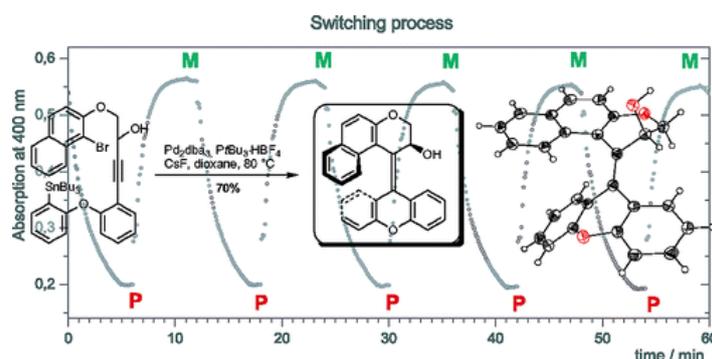


The control of metal–ligand exchange in a confined environment is of primary importance for understanding thermodynamics and kinetics of the electron transfer process governing the reactivity

of enzymes. This study reveals an unprecedented change of the $\text{Cu}^{\text{II}}/\text{Cu}^{\text{I}}$ binding and redox properties through a subtle control of the access to the labile site by a protein channel mimic. The cavity effect was estimated from cyclic voltammetry investigations by comparison of two complexes displaying the same coordination sphere (tmpa) and differing by the presence or absence of a calix[6]arene cone surrounding the metal labile site L. Effects on thermodynamics are illustrated by important shifts of $E_{1/2}$ toward higher values for the calix complexes. This is ascribable to the protection of the labile site of the open-shell system from the polar medium. Such a cavity control also generates specific stabilizations. This is exemplified by an impressively exalted affinity of the calixarene system for MeCN, and by the detection of a kinetic intermediate, a noncoordinated DMF guest molecule floating inside the cone. Kinetically, a unique dissymmetry between the Cu^{I} and Cu^{II} ligand exchange capacity is highlighted. At the CV time scale, the guest interconversion is only feasible after reduction of Cu^{II} to Cu^{I} . Such a redox-switch mechanism results from the blocking of the associative process at the Cu^{II} state, imposed by the calixarene funnel. All of this suggests that the embedment of a reactive redox metal ion in a funnel-like cavity can play a crucial role in catalysis, particularly for metallo-enzymes associating electron transfer and ligand exchange.

- Synthesis of Chiroptical Molecular Switches by Pd-Catalyzed Domino Reactions
Tietze, L. F.; Düfert, A.; Lotz, F.; Sölter, L.; Oum, K.; Lenzer, T.; Beck, T.; Herbst-Irmer, R. *J. Am. Chem. Soc.* 2009, *131*, 17879–17884.

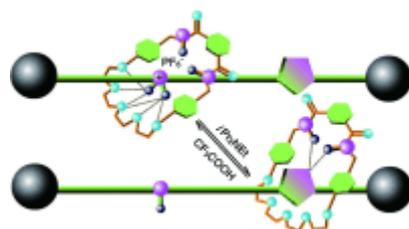
Abstract:



New photochromic switches based on helical alkenes can quickly and efficiently be accessed by Pd-catalyzed domino reactions using a modular approach; this allows a wide variability in product formation with the advantages of a convergent synthetic route. The alkenes have been synthesized in excellent enantioselectivity and their switching properties assessed by stimulation with nanosecond laser pulses at two different wavelengths in over 1000 switching cycles.

- A Dual-Response [2]Rotaxane Based on a 1,2,3-Triazole Ring as a Novel Recognition Station
Zheng, H.; Zhou, W.; Lv, J.; Yin, X.; Li, Y.; Liu, H.; Li, Y. *Chem. Eur. J.* 2009, *15*, 12653-12662.

Abstract:



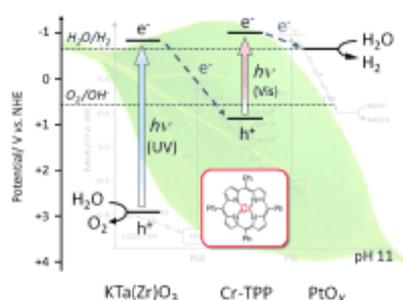
Two novel multilevel switchable [2]rotaxanes containing an ammonium and a triazole station have been constructed by a Cu^{I} -catalyzed azide-alkyne cycloaddition reaction. The macrocycle of

[2]rotaxane containing a C6-chain bridge between the two hydrogen bonding stations exhibits high selectivity for the ammonium cation in the protonated form. Interestingly, the macrocycle is able to interact with the two recognition stations when the bridge between them is shortened. Upon deprotonation of both [2]rotaxanes, the macrocycle moves towards the triazole recognition site due to the hydrogen-bond interaction between the triazole nitrogen atoms and the amide groups in the macrocycle. Upon addition of chloride anion, the conformation of [2]rotaxane is changed because of the cooperative recognition of the chloride anion by a favorable hydrogen-bond donor from both the macrocycle isophthalamide and thread triazole CH proton.

- Charge-Transfer Mechanism in Pt/KTa(Zr)O₃ Photocatalysts Modified with Porphyrinoids for Water Splitting

Hagiwara, H.; Inoue, T.; Kaneko, K.; Ishihara, T. *Chem. Eur. J.* **2009**, *15*, 12862-12870.

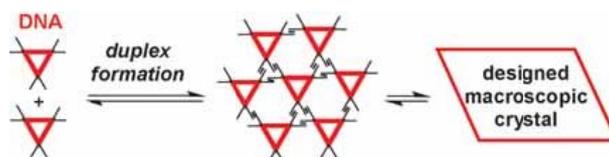
Abstract:



The mechanism of photocatalytic splitting of H₂O into H₂ and O₂ on Pt/KTa(Zr)O₃ modified with various porphyrinoids was investigated. The photocatalytic activity of KTaO₃ catalysts is improved by dye modification. Cyanocobalamin (vitamin B₁₂) is the most effective for improving water-splitting activity, and the formation rates of H₂ and O₂ achieved values of 575 and 280 $\mu\text{mol g}_{\text{cat.}}^{-1} \text{h}^{-1}$, respectively. X-ray photoelectron spectroscopy spectra of KTa(Zr)O₃ photocatalysts showed that Pt loaded onto dye-modified KTaO₃ was slightly oxidized and had low catalytic activity for the H₂ oxidation reaction. Photoluminescence (PL) spectra of KTaO₃ catalysts suggested that excitation energy was transferred between KTaO₃, tetraphenylporphyrinatochromium(III) (Cr-TPP), and the Pt cocatalyst. The wavelength dependence of the activity of dye-modified KTa(Zr)O₃ photocatalysts indicated that excitation of both KTa(Zr)O₃ and the dye was essential for achieving increased photocatalytic activity. This result suggests that two-step excitation occurred in the dye-modified KTa(Zr)O₃ photocatalysts. Because the lifetime of the charge-separated state increased, this study reveals that modification with porphyrinoids is effective for increasing water-splitting activity.

- Designed DNA Crystals: Triangles with Short Sticky Ends
Richert, C.; Meng, M.; Singh, A. *Small* **2009**, *5*, 2782-2783.

Abstract:

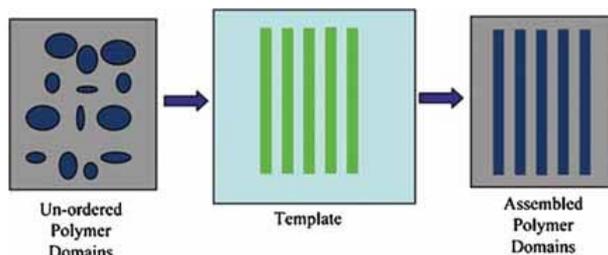


Crystallization, as a process, is difficult to predict and obtaining high-quality crystals is more of an art than a solved technological problem. DNA nanotechnology now delivers design-based crystals with unit-cell dimensions on the nanometer scale that can be generated from oligonucleotides (see image) and that hold promise for many applications.

- Multiscale Directed Assembly of Polymer Blends Using Chemically Functionalized Nanoscale-Patterned Templates

Chiota, J.; Shearer, J.; Wei, M.; Barry, C.; Mead, J. *Small* **2009**, *5*, 2788-2791.

Abstract:

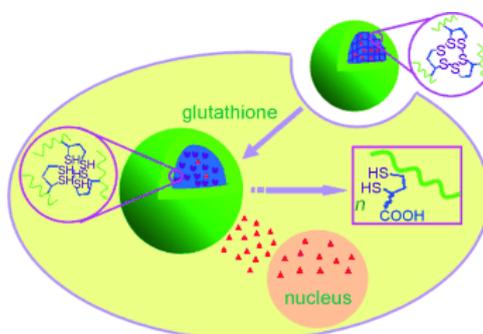


This study focuses on the rapid directed nanoscale assembly of polystyrene/polymethyl methacrylate blends into complex patterns of non-uniform geometries at multiple length scales on a single template. The patterns were created using alkanethiols on gold templates (see image) patterned by dip-pen nanolithography. These chemically functionalized nanotemplates direct the nanoscale assembly of polymer blends into non-uniform patterns in short.

- Reversibly Stabilized Multifunctional Dextran Nanoparticles Efficiently Deliver Doxorubicin into the Nuclei of Cancer Cells

Li, Y.-L.; Zhu, L.; Liu, Z.; Cheng, R.; Meng, F.; Cui, J.-H.; Ji, S.-J.; Zhong, Z. *Angew. Chem. Int. Ed.* **2009**, *48*, 9914–9918.

Abstract:

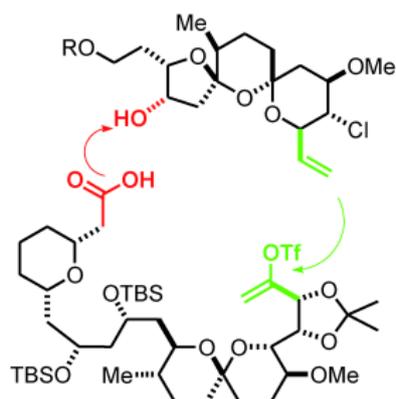


Getting in there: Efficient intracellular delivery of anticancer drugs is achieved by using reversibly cross-linked dextran nanoparticles, which are rapidly destabilized under reductive environments that mimic those of the intracellular compartments. These nanoparticles show high drug loading efficiency and reduction-triggered release of doxorubicin *in vitro* as well as inside tumor cells, particularly to the cell nucleus (see scheme).

- Total Synthesis of Spirastrellolide F Methyl Ester—Part 1: Strategic Considerations and Revised Approach to the Southern Hemisphere

O’Neil, G. W.; Ceccon, J.; Benson, S.; Collin, M.-P.; Fasching, B.; Furstner, A. *Angew. Chem. Int. Ed.* **2009**, *48*, 9940–9945.

Abstract:

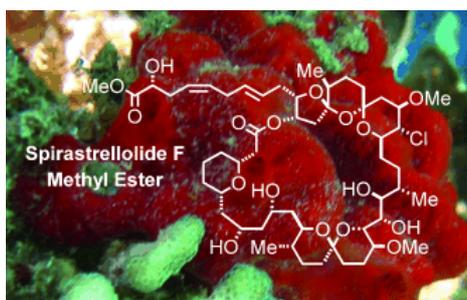


In readiness for closure: To ensure optimal convergence in the projected total synthesis of spirastrellolide F, the building block representing the southern hemisphere was prepared with a free carboxylic acid and an enol triflate (Tf) terminus (see picture). This unusual pattern allows the 38-membered macrocyclic core of this potent antimitotic agent to be constructed, while keeping late-stage protecting-group manipulations to a minimum.

- Total Synthesis of Spirastrellolide F Methyl Ester - Part 2: Macrocyclization and Completion of the Synthesis

Benson, S.; Collin, M.-P.; O'Neil, G. W.; Ceccon, J.; Fasching, B.; Fenster, M. D. B.; Godbout, C.; Radkowski, K.; Goddard, R.; Fürstner, A. *Angew. Chem. Int. Ed.* **2009**, *48*, 9946–9950.

Abstract:

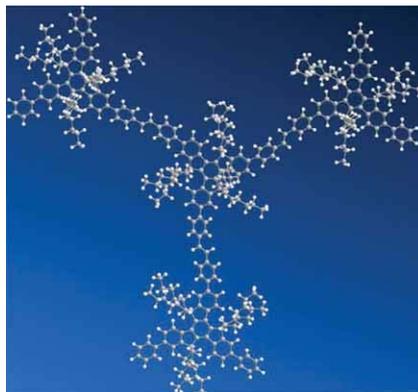


Marvel of the sea: A concise and highly convergent total synthesis of the methyl ester of the marine macrolide spirastrellolide F (see picture), which has exquisite antimitotic properties, is reported. In this approach, the northern and the southern hemispheres of this intricate target are stitched together in only two consecutive steps (Suzuki coupling, Yamaguchi lactonization) without any interim protecting-group manipulations.

- Highly Efficient and Color-Stable Deep-Blue Organic Light-Emitting Diodes Based on a Solution-Processible Dendrimer

Wang, L.; Jiang, Y.; Luo, J.; Zhou, Y.; Zhou, J.; Wang, J.; Pei, J.; Cao, Y. *Adv. Mater.* **2009**, *21*, 4854-4858.

Abstract:

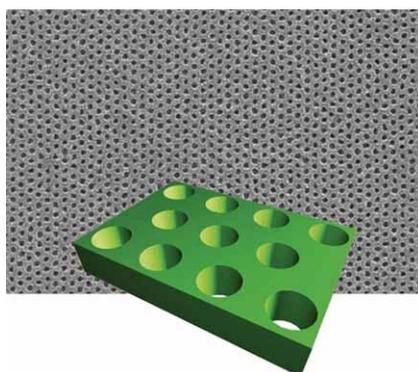


A **color-stable blue organic light-emitting diode** is obtained utilizing a solution-processible fluorescent π -conjugated dendrimer **GO** (see image), with a maximum luminance efficiency of 5.3 cd A^{-1} . Efficient green, red, and white OLEDs are also demonstrated by doping **GO** with phosphorescent dyes. Combining high device efficiency with solution processibility, **GO** becomes one of the best blue-emitting materials for fabricating flat-panel displays and white-light lighting panels via solution processing.

- Block Copolymer Nanolithography: Translation of Molecular Level Control to Nanoscale Patterns

Bang, J.; Jeong, U.; Ryu, D. Y.; Russell, T. P.; Hawker, C. J. *Adv. Mater.* **2009**, *21*, 4769-4792.

Abstract:

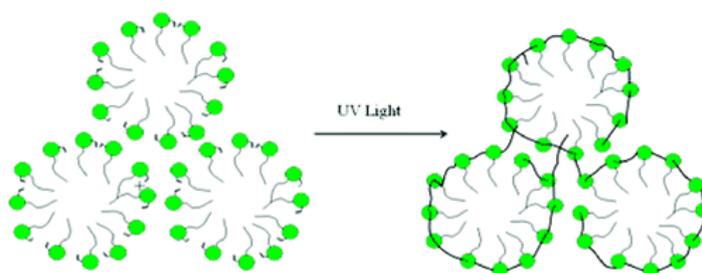


The self-assembly of block copolymers is a promising platform for the “bottom-up” fabrication of nanostructured materials and devices. This review covers some of the advances made in this field from the laboratory setting to applications where block copolymers are in use.

- Polymerization Kinetics and Nanostructure Evolution of Reactive Lyotropic Liquid Crystals with Different Reactive Group Position

Sievens-Figueroa, L.; Guymon, C. A. *Macromolecules* **2009**, *42*, 9243–9250.

Abstract:

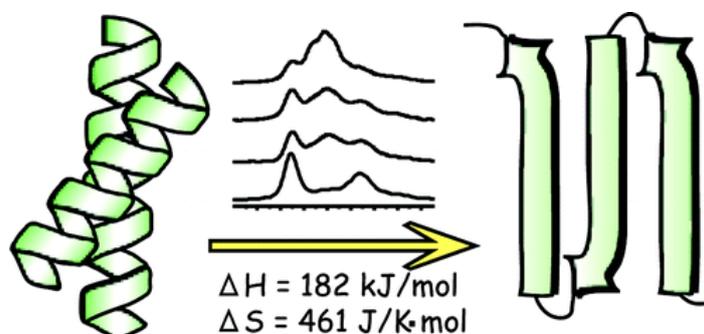


The synthesis of polymers with inherent nanostructure has recently received much attention because of the wide range of potential application in which these materials could be used. To understand the factors that affect the nanoscopic order preservation upon polymerization, this work examines the influence of reactive group position in polymerizable surfactants that form reactive lyotropic liquid crystals (LLCs) on polymerization kinetics and order before and after polymerization. Less ordered LLC phases are formed with reactive surfactants bearing reactive groups in the nonpolar tail compared to reactive surfactants with reactive groups near the polar head. The polymerization kinetics are influenced by both the LLC order and the position of the reactive group. Higher polymerization rates are observed for reactive surfactants with the reactive group near the polar head with increasing surfactant concentration and LLC order. On the other hand, lower polymerization rates are observed for the reactive surfactant with the reactive group in the aliphatic tail at higher surfactant concentrations and LLC order. This behavior is mainly due to segregation of the reactive groups in different regions of the LLC phases as indicated by an apparent increase in both the propagation and termination kinetic constants. When using initiators that induce higher polymerization rates, greater LLC order preservation is observed after polymerization. Also, by using higher light intensities, the resulting polymer exhibits higher degrees of LLC order retention than that observed when polymerization is initiated with lower light intensities and corresponding lower polymerization rate.

- Thermodynamics in Conformational Transition of Poly(β -benzyl L-aspartate) As Studied by High-Resolution Solid-State ^{13}C NMR Spectroscopy.

Nakanishi, A.; Shoji, A.; Takegoshi, K. *Macromolecules* **2009**, *42*, 9307–9311.

Abstract:



The thermodynamic characteristics associated with conformational change of poly(β -benzyl L-aspartate) (PBLA) in the solid state are studied by using ^{13}C high-resolution solid-state NMR. PBLA was chosen because four different conformations, i.e., the right-handed (RR-) and left-handed R-helices (RL-helix), left-handed ω -helix (ω L-helix), and antiparallel β -sheet (β -sheet), can be prepared separately, and the thermally induced transition occurs among them. In this work, we analyze spectral changes due to conformational transformation of PBLA and determine the enthalpic and entropic changes associated with the transformation of RR-helix to other conformations; the enthalpic change ΔH per residue becomes ca. 1.4 kJ mol^{-1} , and the entropic change ΔS per residue becomes ca. $3.5 \text{ JK}^{-1} \text{ mol}^{-1}$. With using these ΔH and ΔS values, we show that the observed transition curve can be reproduced by a simple statistical model.