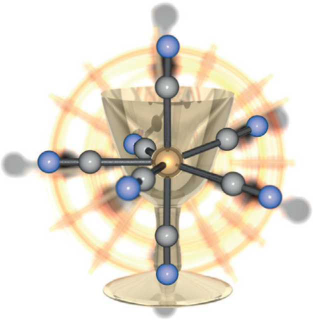
# Non-enzymatic variations …

… of posttranslational modifications (nPTMs) form through reactions of electrophilic metabolites (here, in the eye) with nucleophilic protein side chains (arginine in the hourglass). Such modifications accumulate over time, but are poorly understood at the molecular level. In their Communication on page 11397 ff., C. F. W. Becker and co-workers report on the impact of the nPTM argpyrimidine on the structure and activity of a human chaperone protein. (Image: iStock.com/ Dmytro Kozlov.)

***Magnetic Anisotropy***

K. R. Dunbar and co-workers report in their Communication on page 11368 ff. the synthesis and characterization of a previously unknown heptacyanotungstate(IV) anion that has an extraordinarily large positive zero-field splitting parameter.



***Cell Growth***

Enhanced cell growth occurs on a titanium surface modified with insulin-like growth-factor-1. As shown by Y. Ito and co-workers in their Communication on page 11447 ff., the approach has potential for medical implants.

***Energetic Materials***

In their Communication on page 11472 ff., A. M. Churakov et al. report the synthesis of a new high-energy nitrogen system 1,2,3,4-tetrazino[5,6-e]-1,2,3,4-tetrazine-1,3,6,8-tetraoxide.

## How to contact us:

***Editorial Office:***
*E-mail:* angewandte@wiley-vch.de
*Fax:* (+49) 6201–606-331
*Telephone:* (+49) 6201–606-315

***Reprints, E-Prints, Posters, Calendars:***
Carmen Leitner
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*Fax:* (+49) 6201–606-331
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*E-mail:* rights-and-licences@wiley-vch.de
*Fax:* (+49) 6201–606-332
*Telephone:* (+49) 6201–606-280

***Online Open:***
Margitta Schmitt
*E-mail:* angewandte@wiley-vch.de
*Fax:* (+49) 6201–606-331
*Telephone:* (+49) 6201–606-315

***Subscriptions:***
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Marion Schulz
*E-mail:* mschulz@wiley-vch.de
*Fax:* (+49) 6201–606-550
*Telephone:* (+49) 6201–606-565

***Courier Services:***
Boschstrasse 12, 69469 Weinheim

***Regular Mail:***
Postfach 101161, 69451 Weinheim

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## Service

## Author Profile

*"If I could be anyone for a day, I would be Bono. The biggest challenge facing scientists is being heard by politicians and decision makers. …"*
This and more about Olivier Baudoin can be found on page 11332.

## News

L. E. Overman

M. C. White

H. Yorimitsu

K. Kern

C. Wöll

J. J. Gooding

M. Antonietti

K. Müllen

M. Sommer

F. R. Wurm

## Obituaries

Ahmed Hassan Zewail, Linus Pauling Professor of Chemistry, Professor of Physics, and Director of the Physical Biology Center for Ultrafast Science and Technology at the California Institute of Technology passed away on August 2, 2016. Zewail, who was awarded the 1999 Nobel Prize in Chemistry, introduced femtosecond laser techniques and 4D electron microscopy that revolutionized chemistry and related sciences.

Ahmed Hassan Zewail (1946–2016)

S. J. M. Thomas* ______ **11335 – 11336**

## Books

Domino and Intramolecular Rearrangement Reactions as Advanced Synthetic Methods in Glycosciences

Z. J. Witczak, R. Bielski

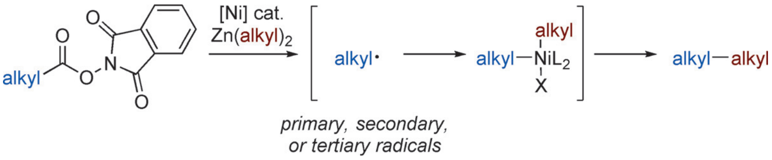
*reviewed by S. J. Sucheck** **11337 – 11338**

## Highlights

### Cross-Coupling

M. O. Konev, E. R. Jarvo* **11340 – 11342**

Decarboxylative Alkyl–Alkyl Cross-Coupling Reactions



**Alkyl with alkyl**: A significant development in alkyl–alkyl cross-coupling reactions, namely the nickel-catalyzed decarboxylative Negishi coupling of *N*-hydroxyphthalimide esters, was recently reported by Baran and co-workers. This method enables the synthesis of various highly functionalized compounds, including natural product derivatives.

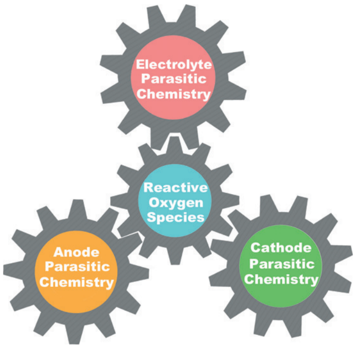
## Minireviews

### Energy Storage

X. Yao, Q. Dong, Q. Cheng, D. Wang* ______ **11344 – 11353**

Why Do Lithium–Oxygen Batteries Fail: Parasitic Chemical Reactions and Their Synergistic Effect

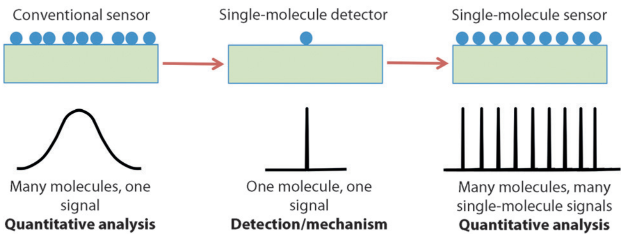
**Synergistic effect**: In lithium–oxygen batteries reactive oxygen species are found to be a key chemical mediator that participates in or facilitates nearly all parasitic chemical reactions at the anode, cathode, and electrolyte. Understanding of their synergistic effect will enable more rational designs for future lithium–oxygen batteries.



**For the USA and Canada:**
ANGEWANDTE CHEMIE International Edition (ISSN 1433-7851) is published weekly by Wiley-VCH, PO Box 101161, 69451 Weinheim, Germany. US mailing agent: SPP, PO Box 437, Emigsville, PA 17318. Periodicals postage paid at Emigsville, PA. US POSTMASTER: send address changes to *Angewandte Chemie*, John Wiley & Sons Inc., C/O The Sheridan Press, PO Box 465, Hanover, PA 17331. Annual subscription price for institutions: US$ 16.862/14.051 (valid for print and electronic / print or electronic delivery); for individuals who are personal members of a national chemical society prices are available on request. Postage and handling charges included. All prices are subject to local VAT/sales tax.

## Reviews

### Sensors



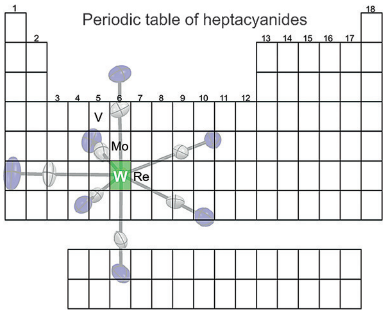
**More than the sum of its parts**: Advances in measurement science have seen a progressive reduction in sample size to the point that single-molecule measurements are today commonplace. A new generation of sensors is expected that perform quantitative analysis by measuring many single-molecule events. This Review discusses the challenges, opportunities, and recent developments in quantitative single-molecule sensors.

## Communications

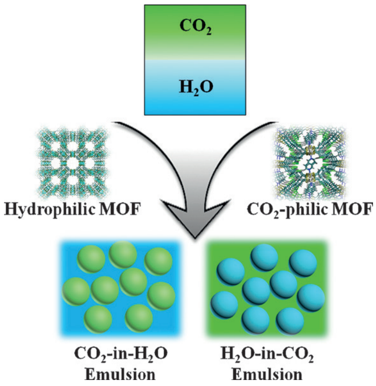
### Tungsten Cyanide Complexes

Frontispiece

**W(e) are family**: A previously unknown heptacyanotungstate(IV) anion has been synthesized and characterized structurally and magnetically. It is the first member of the heptacyanide family with $S=1$ and exhibits an extraordinarily large positive zero field splitting parameter $D$.



### MOFs as Emulsifiers



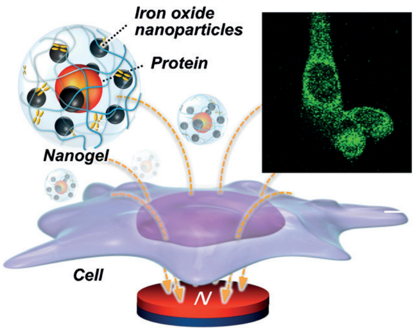
**MOFing to get all emulsional about**: Metal–organic frameworks (MOFs) are used as emulsifiers for emulsifying $CO_2$ and water. The MOF-stabilized $CO_2$ and water emulsion has exceptional stability and is “tunable” as a result of varying the MOF and adjustable character of $CO_2$. Releasing the gas from the emulsion provides a facile route for constructing novel MOF superstructures.

## Drug Delivery

R. Kawasaki, Y. Sasaki,* K. Katagiri,
S. Mukai, S. Sawada,
K. Akiyoshi* ______ **11377 – 11381**

Magnetically Guided Protein Transduction by Hybrid Nanogel Chaperones with Iron Oxide Nanoparticles

**Protein delivery**! Facile protein transduction was achieved using a hybrid of polysaccharide nanogels with iron oxide nanoparticles. The chaperone-like functions of the nanogel and magnetic properties of the iron oxide nanoparticles enabled delivery of functional proteins, while maintaining their innate activities, into target cells.



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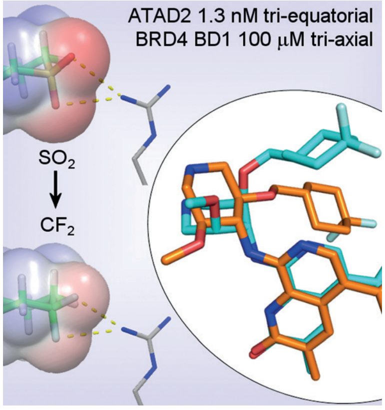
## Epigenetics

P. Bamborough,* C. Chung,
E. H. Demont,* R. C. Furze,
A. J. Bannister, K. H. Che, H. Diallo,
C. Douault, P. Grandi, T. Kouzarides,
A.-M. Michon, D. J. Mitchell, R. K. Prinjha,
C. Rau, S. Robson, R. J. Sheppard,
R. Upton, R. J. Watson __ **11382 – 11386**

A Chemical Probe for the ATAD2 Bromodomain



**ANCCA away**: ATAD2 or ANCCA is a cancer-associated bromodomain-containing protein. Starting from a potent lead, permeability and selectivity over BET bromodomains were improved by 1) using $CF_2$ as a sulfone bio-isostere to exploit the unique properties of fluorine, and 2) using 1,3-interactions to control the conformation of a piperidine ring. GSK8814 is the first low-nanomolar, selective and cell-permeable chemical probe for ATAD2.

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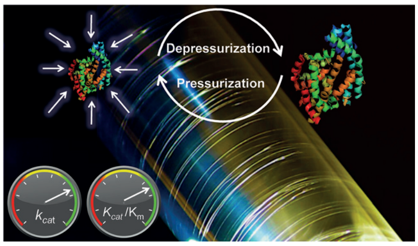
## Biocatalysis

J. Britton, L. M. Meneghini, C. L. Raston,*
G. A. Weiss* ______ **11387 – 11391**

Accelerating Enzymatic Catalysis Using Vortex Fluidics



**Enzymes, they're picking up good vibrations**: A simple, generalizable approach to accelerate enzymes through the use of pressure waves in thin films has been developed. Each enzyme responds best to specific vibrations, uncovering a previously unappreciated aspect of biocatalysis.

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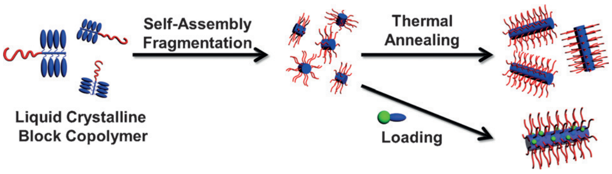
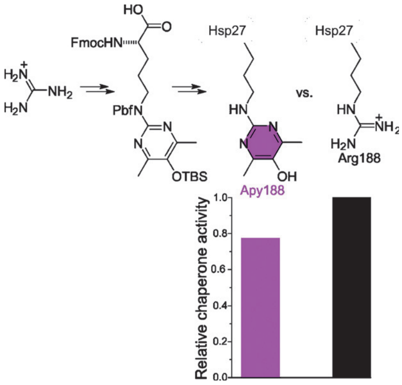
## Micelles

X. Y. Li,* B. X. Jin, Y. Gao, D. W. Hayward,
M. A. Winnik, Y. J. Luo,*
I. Manners* ______ **11392 – 11396**

Monodisperse Cylindrical Micelles of Controlled Length with a Liquid-Crystalline Perfluorinated Core by 1D "Self-Seeding"



**"Liquid" centers**: Cylindrical block copolymer micelles with a perfluorinated liquid-crystalline core-forming block undergo a fragmentation-thermal annealing process that resembles the "self-seeding" phenomenon. The resulting cylindrical micelles have a controlled length and a narrow length distribution. The cylinders can be used as a cargo-carrier, as shown with a fluorescent dye.



**Underinvestigated protein modifications**: The non-enzymatic posttranslational modification (nPTM) argpyrimidine (Apy) was incorporated into Hsp27 through protein semisynthesis, and the impact was investigated at the molecular level. Apy was found to reduce Hsp27 chaperone activity and oligomerization, without affecting folding. This suggests that nPTMs are able to alter protein function.

## Posttranslational Modifications

**Front Cover**

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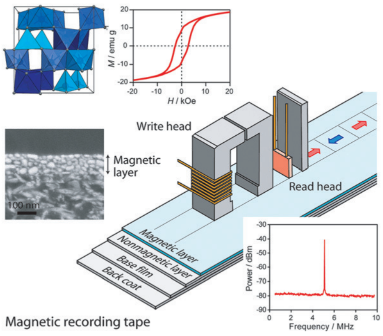
**For the record**: A new series of metal-substituted ε-$Fe_2O_3$ nanoparticles, ε-$Ga^{III}_{0.31}Ti^{IV}_{0.05}Co^{II}_{0.05}Fe^{III}_{1.59}O_3$, with an average size of 18 nm was prepared. The Ga, Ti, and Co cations tune the magnetic properties of ε-$Fe_2O_3$ to the specifications demanded for a magnetic recording tape. The fabricated magnetic tape showed a remarkably high signal-to-noise ratio. This series of materials should be applicable for data storage in the big-data era.



## Magnetic Materials

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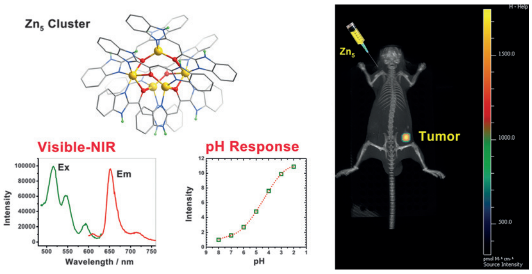

**Zn shines through**: A small $Zn_5$ coordination cluster, emitting in the visible-to-near-infrared region under visible light excitation and having high stability, pH sensitivity, and negligible cytotoxicity, is applied as a novel sensitive fluorescent probe for non-invasive in vivo imaging of tumors as small as 13.5 mm$^3$.

## Imaging Techniques

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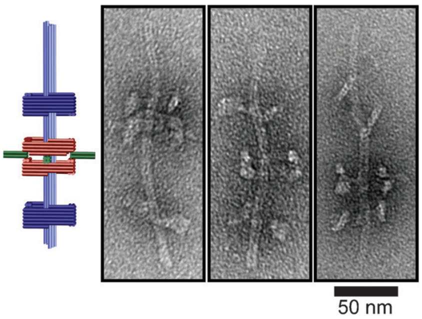
**A new set of threads**: Rotaxanes with a length of up to 200 nm were assembled by a DNA origami approach. The threaded macrocycles can be programmably docked at either dumbbell stopper, and the assemblies can be reconfigured to generate new, otherwise unfavorable rotaxane topologies.



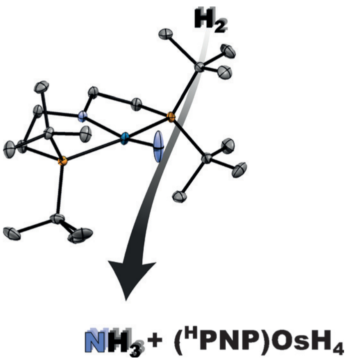
## DNA Nanotechnology

### Nitrogen Fixation

F. S. Schendzielorz, M. Finger,
C. Volkmann, C. Würtele,
S. Schneider* ________ 11417 – 11420

## A Terminal Osmium(IV) Nitride: Ammonia Formation and Ambiphilic Reactivity

**The first rational synthesis** for an isolable osmium(IV) nitride is reported. The title compound $[Os(N)\{N(CH_2CH_2PtBu_2)_2\}]$ shows ambiphilic nitride reactivity and gives ammonia upon hydrogenolysis with $H_2$ in high yield. These results emphasize the role of low-valent osmium nitrides and $H_2$ heterolysis for nitrogen fixation strategies.



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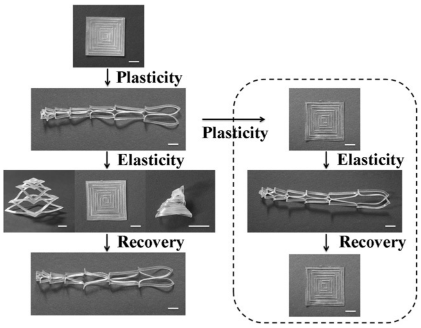
### Plasticity

N. Zheng, Z. Z. Fang, W. K. Zou,
Q. Zhao,* T. Xie* ________ 11421 – 11425

## Thermoset Shape-Memory Polyurethane with Intrinsic Plasticity Enabled by Transcarbamoylation

**Inside Cover**

**Thermoset polymers** are known for their superior thermomechanical properties, but the chemical crosslinking typically leads to intractability. However, a classical thermoset shape-memory polyurethane was now shown to be readily capable of permanent reshaping (plasticity) after a topological network rearrangement that is induced by transcarbamoylation.



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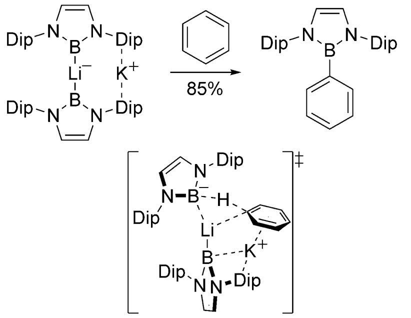
### Superbases

T. Ohsato, Y. Okuno, S. Ishida, T. Iwamoto,
K.-H. Lee, Z. Lin,* M. Yamashita,*
K. Nozaki* ________ 11426 – 11430

## A Potassium Diboryllithate: Synthesis, Bonding Properties, and the Deprotonation of Benzene

**A 'LiK ' of work**: A potassium diboryllithate, $B_2LiK$, was synthesized and structurally characterized. The bonding situation in this compound was examined by NMR, XRD, NPA, and AIM analyses. $B_2LiK$ is able to deprotonate benzene with concomitant formation of phenylborane as the major product. A detailed reaction mechanism based on DFT calculations suggests that the deprotonation of benzene should be initiated by a transition state involving the coordination of benzene to $K^+$.



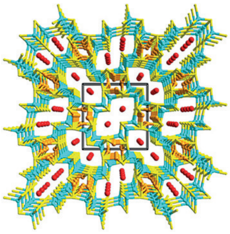
transition state for initial key step:
deprotonation of benzene

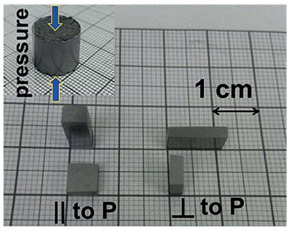
---

### Thermoelectric Materials

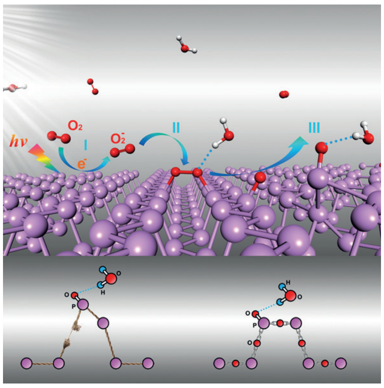
H. Lin, G. Tan, J. N. Shen, S. Q. Hao,
L. M. Wu,* N. Calta, C. Malliakas,
S. Wang, C. Uher, C. Wolverton,
M. G. Kanatzidis* ________ 11431 – 11436

## Concerted Rattling in $CsAg_5Te_3$ Leading to Ultralow Thermal Conductivity and High Thermoelectric Performance





**A p-type thermoelectric** material, $CsAg_5Te_3$, is presented. It exhibits ultralow thermal conductivity ($\kappa_{tol} \approx 0.18\ Wm^{-1}K^{-1}$) and a high figure of merit (ZT ≈ 1.5 at 727 K). The low thermal conductivity is attributed to a previously unrecognized phonon scattering mechanism that involves the rattling of Ag ions, strongly raising the Grüneisen parameters of the material.

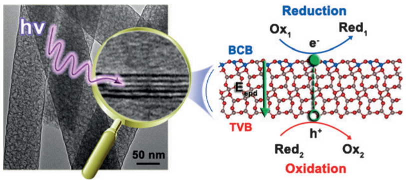


**Protected by native oxide**: A three-step picture of the ambient degradation of black phosphorus (BP) is given. A possible protection strategy using a fully oxidized BP layer as the capping is proposed. Such a fully oxidized layer can resist corrosion from water and leave the BP underneath intact with simultaneous high hole mobility.

## Black Phosphorus

---

**A real GaIn for HER**: A porous Ga and In containing bimetallic oxide nano-photocatalyst with atomically thin pore walls is synthesized. The material has a unique electronic structure that is highly useful for photocatalysis, as demonstrated here with its ability to efficiently photocatalyze the hydrogen evolution reaction.



## Photocatalysis

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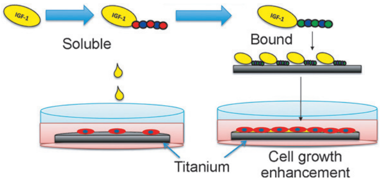
**For use in humans**, including as artificial dental implants and joint replacements, a titanium surface was modified with insulin-like growth-factor-1 prepared by a bioorthogonal approach combining protein engineering and enzyme modification. The result was enhanced cell growth on the coated metal surfaces.



## Cell Growth

**Inside Back Cover**

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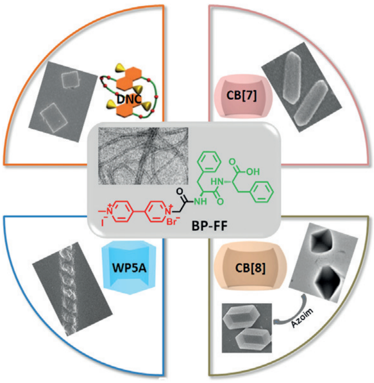


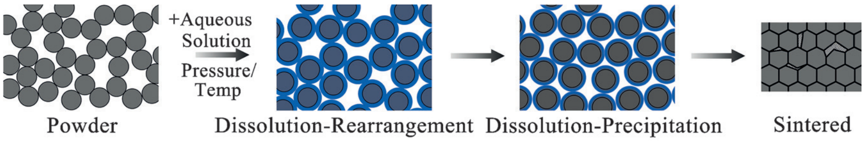
**Be my guest**: A variety of morphologically interesting aggregates have been constructed. The method uses supramolecular modulation of a bipyridinium-modified diphenylalanine guest with four different macrocyclic hosts. Azoim = azophenyl imidazolium salt.

## Supramolecular Assembly

## Sintering

J. Guo, H. Guo, A. L. Baker, M. T. Lanagan,
E. R. Kupp, G. L. Messing,
C. A. Randall* ________ **11457 – 11461**

Cold Sintering: A Paradigm Shift for Processing and Integration of Ceramics

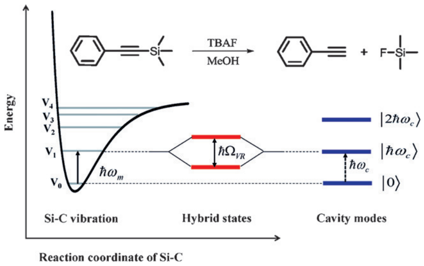


**A breakthrough** in the sintering of ceramics named “cold sintering process” (CSP) is introduced. Wide ranges of inorganic materials and composites can be sintered at much lower temperatures (between room temperature and 200 °C) than previously thought possible by using water as a transient liquid phase to effect densification by a mediated solution–precipitation process.

## Kinetics

A. Thomas, J. George, A. Shalabney,
M. Dryzhakov, S. J. Varma, J. Moran,
T. Chervy, X. Zhong, E. Devaux, C. Genet,
J. A. Hutchison,
T. W. Ebbesen* ________ **11462 – 11466**

Ground-State Chemical Reactivity under Vibrational Coupling to the Vacuum Electromagnetic Field



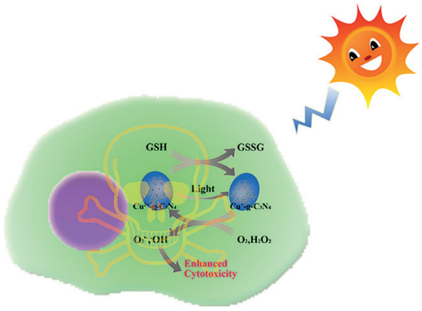
**The ground-state deprotection** of a simple alkynylsilane is studied under vibrational strong coupling to the vacuum electromagnetic field of a resonant optical cavity. When the Si–C vibrational stretching modes are strongly coupled, the reaction slows down significantly. The relative change in the reaction rate under strong coupling depends on the Rabi splitting energy.

## Nanomaterials for Cancer Therapy

E. Ju, K. Dong, Z. Chen, Z. Liu, C. Liu,
Y. Huang, Z. Wang, F. Pu, J. Ren,*
X. Qu* ________ **11467 – 11471**

Copper(II)–Graphitic Carbon Nitride Triggered Synergy: Improved ROS Generation and Reduced Glutathione Levels for Enhanced Photodynamic Therapy

**Looks like a job for a copper**: The integration of $Cu^{2+}$ with graphitic carbon nitride (g-$C_3N_4$) nanosheets greatly improved the efficiency of these photosensitizers for photodynamic therapy. The observed improvement in cytotoxicity was due to the enhanced light-triggered generation of reactive oxygen species in combination with the depletion of intracellular glutathione (GSH) levels (see picture).



## Energetic Materials

M. S. Klenov, A. A. Guskov, O. V. Anikin,
A. M. Churakov,* Y. A. Strelenko,
I. V. Fedyanin, K. A. Lyssenko,
V. A. Tartakovsky ________ **11472 – 11475**

Synthesis of Tetrazino-tetrazine 1,3,6,8-Tetraoxide (TTTO)

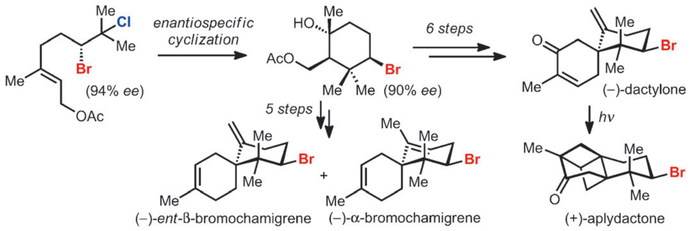
**Back Cover**

**A butterfly-like high-nitrogen structure**: A ten-step synthesis of TTTO (see picture) has been accomplished. The synthetic strategy was based on the sequential closure of two 1,2,3,4-tetrazine 1,3-dioxide rings by the generation of oxodiazonium ions and their intramolecular coupling with *tert*-butyl-*NNO*-azoxy groups. TTTO is considered as a new high-energy compound.

## Asymmetric Synthesis

A. J. Burckle, V. H. Vasilev, N. Z. Burns* ________ 11476 – 11479

A Unified Approach for the Enantioselective Synthesis of the Brominated Chamigrene Sesquiterpenes



**Dihalides light the way**: A stereospecific bromopolyene cyclization of an enantiomerically enriched bromochloride was developed as a highly general approach to the brominated chamigrene sesquiterpenes (see scheme). The total synthesis of (+)-aplydactone was completed by an intramolecular [2+2] cycloaddition.

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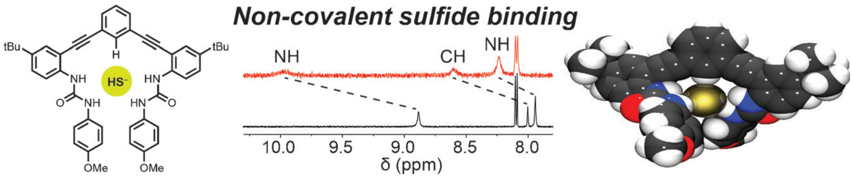
## Host–Guest Systems

M. D. Hartle, R. J. Hansen, B. W. Tresca, S. S. Prakel, L. N. Zakharov, M. M. Haley,* M. D. Pluth,* D. W. Johnson* ________ 11480 – 11484

A Synthetic Supramolecular Receptor for the Hydrosulfide Anion



**Swaddling smelly sulfide supramolecularly**: Long known for its malodor and toxicity, hydrogen sulfide is the most recently discovered endogenously produced gasotransmitter. The first synthetic receptor for the reversible binding of $HS^-$ is reported and characterized spectroscopically in solution and crystallographically.

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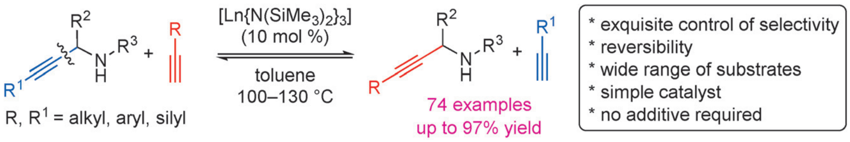
## Synthetic Methods

Y. Shao, F. Zhang, J. Zhang, X. Zhou* ________ 11485 – 11489

Lanthanide-Catalyzed Reversible Alkynyl Exchange by Carbon–Carbon Single-Bond Cleavage Assisted by a Secondary Amino Group



**A good swap**: Lanthanide-catalyzed alkynyl exchange through C–C single-bond cleavage enabled the selective transformation of internal propargylamines into differently substituted propargylamines in moderate to excellent yields. As an alternative to metathesis for the reconstruction of alkynes, this reaction has significant advantages, such as broad scope and excellent control of selectivity.

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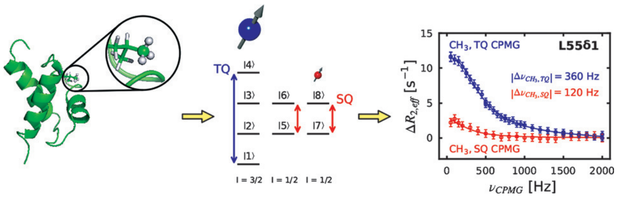
## NMR Spectroscopy

VIP

T. Yuwen, P. Vallurupalli, L. E. Kay* ________ 11490 – 11494

Enhancing the Sensitivity of CPMG Relaxation Dispersion to Conformational Exchange Processes by Multiple-Quantum Spectroscopy

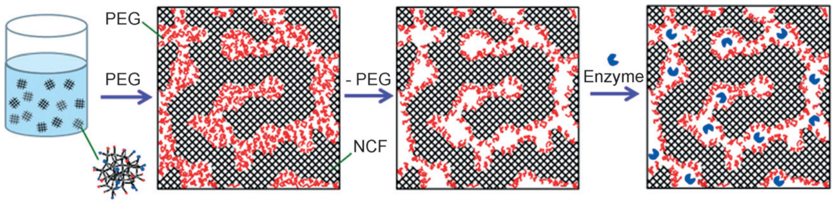


**All good things come in threes**: A triple-quantum $^1H$ CPMG relaxation dispersion experiment focusing on $^{13}CH_3$-labeled methyl groups in proteins is presented. It detects protein dynamics on the millisecond timescale with much higher sensitivity than the corresponding single-quantum variant, as the dispersion profiles can be as much as nine times larger.

### Biocatalysis

J.-S. Bae, E. Jeon, S.-Y. Moon, W. Oh,
S.-Y. Han, J.-H. Lee, S. Y. Yang,*
D.-M. Kim, J.-W. Park* **11495 – 11498**

Bicontinuous Nanoporous Frameworks: Caged Longevity for Enzymes



**In a gilded cage**: A bicontinuous nanoporous framework was synthesized by simultaneous phase separation, gelation, and a grafting reaction of the sol mixture of a growing network and polymer. An enzyme caged in the bicontinuous nanoporous film could be recycled many times with nearly no loss of catalytic activity.

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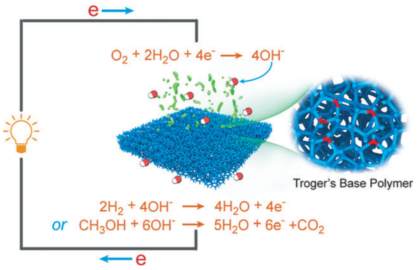
### Anion-Exchange Membranes

Z. Yang, R. Guo, R. Malpass-Evans,
M. Carta, N. B. McKeown,* M. D. Guiver,*
L. Wu, T. Xu* **11499 – 11502**

Highly Conductive Anion-Exchange Membranes from Microporous Tröger's Base Polymers



**Quaternized Tröger's base polymers** provide highly conducting and stable anion-exchange membranes with potential for energy conversion applications. The V-shaped Tröger's base unit stops the polymer chains from packing efficiently, resulting in a subnano-sized intrinsic microporosity, which provides a sponge-like morphology that facilitates rapid anion transport.

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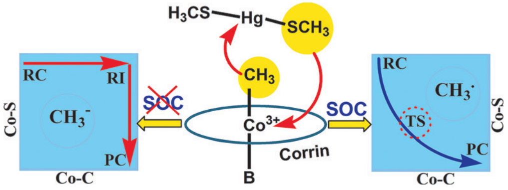
### Reaction Mechanisms

T. B. Demissie, B. D. Garabato, K. Ruud,
P. M. Kozlowski* **11503 – 11506**

Mercury Methylation by Cobalt Corrinoids: Relativistic Effects Dictate the Reaction Mechanism



**Of relative importance**: The methylation of $Hg^{II}(SCH_3)_2$ by corrinoid-based methyl donors proceeds in a concerted manner through a single transition state by transfer of a methyl radical. This reaction mechanism is a consequence of relativistic effects, and constitutes the first example of relativity being decisive for the nature of an enzymatic reaction mechanism. SOC = spin–orbit coupling.

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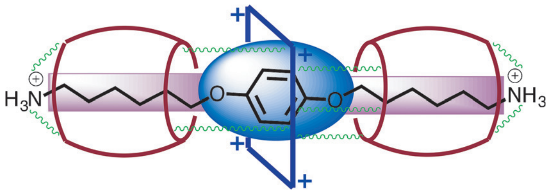
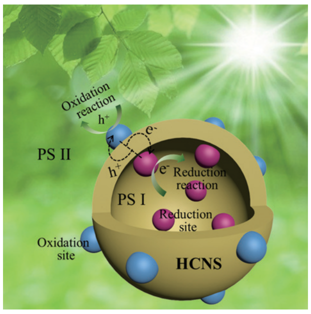
### Supramolecular Chemistry

M. H. Tootoonchi, G. Sharma, J. Calles,
R. Prabhakar,
A. E. Kaifer* **11507 – 11511**

Cooperative Self-Assembly of a Quaternary Complex Formed by Two Cucurbit[7]uril Hosts, Cyclobis(paraquat-*p*-phenylene), and a "Designer" Guest



**A guest** designed and synthesized to have three adjacent binding sites serves as the central component for the highly cooperative assembly of a novel quaternary supramolecular complex. Lateral interactions between the hosts in the final assembly contribute significantly to the cooperative binding.



**Interior design**: A hollow conjugated carbon nitride semiconductor nanosphere with Pt and $Co_3O_4$ nanoparticles on the interior and exterior surfaces, respectively, has been prepared by a precise nanofabrication technology. The nanoparticle co-catalysts enable the Janus hollow structure to photocatalyze water splitting by promoting charge separation and inhibiting the unwanted reverse reaction.

### Water Splitting

D. D. Zheng, X. N. Cao,
X. C. Wang* ———— **11512 – 11516**

Precise Formation of a Hollow Carbon Nitride Structure with a Janus Surface To Promote Water Splitting by Photoredox Catalysis

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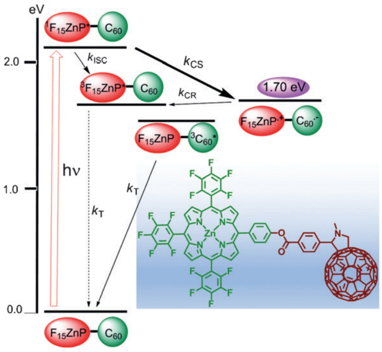

**Keep 'em separated**: A donor–acceptor dyad composed of a high oxidation potential zinc porphyrin covalently linked to $C_{60}$ has been synthesized and shown to generate a high-energy charge-separated state on the order of 1.70 eV and a lifetime in the range of 50–60 ns during photoinduced electron transfer, which is sufficient to carry out many energy (potential) demanding photocatalytic reactions.

### Charge-Separated States

G. N. Lim, C. O. Obondi,
F. D'Souza* ———— **11517 – 11521**

A High-Energy Charge-Separated State of 1.70 eV from a High-Potential Donor–Acceptor Dyad: A Catalyst for Energy-Demanding Photochemical Reactions

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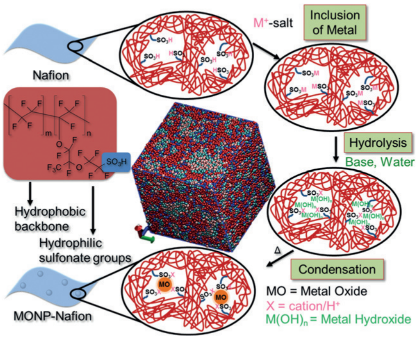

**The factors** governing the in situ growth of metal oxide nanoparticles within a self-segregated polyelectrolyte membrane, Nafion, are investigated. By varying the binary water/alcohol solvent mixture the size, shape, and exposed crystal facets can be tailored.

### Nanoparticle Growth

J. Landers, J. Colon-Ortiz, K. Zong,
A. Goswami, T. Asefa, A. Vishnyakov,
A. V. Neimark* ———— **11522 – 11527**

In Situ Growth and Characterization of Metal Oxide Nanoparticles within Polyelectrolyte Membranes

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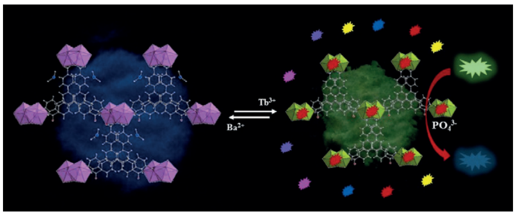


**All change**: Complete alkaline earth metal ($Ba^{2+}$) to rare earth metal ($Tb^{3+}$) metathesis has been achieved in single crystals of a metal–organic framework (MOF). This transmetalated MOF can act as a sensor for phosphate anions.

### Metal–Organic Frameworks

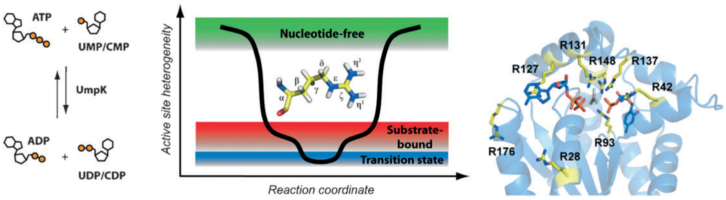
K. S. Asha, R. Bhattacharjee,
S. Mandal* ———— **11528 – 11532**

Complete Transmetalation in a Metal–Organic Framework by Metal Ion Metathesis in a Single Crystal for Selective Sensing of Phosphate Ions in Aqueous Media

## Phosphoryl Transfer

C. Zeymer, N. D. Werbeck, S. Zimmermann, J. Reinstein,* D. F. Hansen* ________ 11533 – 11537

Characterizing Active Site Conformational Heterogeneity along the Trajectory of an Enzymatic Phosphoryl Transfer Reaction



**Conformational heterogeneity** of arginine side chains was quantified for states along the phosphoryl transfer reaction catalyzed by the nucleoside monophosphate kinase UmpK. The catalytically essential groups were found to be remarkably rigid in a transition state analogue complex, indicating that the enzyme evolved to restrict the conformational freedom along its reaction path, which allows the phosphoryl transfer to occur selectively by avoiding side reactions.

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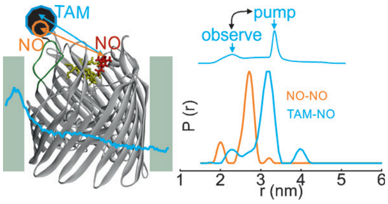
## EPR Spectroscopy

B. Joseph,* V. M. Tormyshev, O. Y. Rogozhnikova, D. Akhmetzyanov, E. G. Bagryanskaya, T. F. Prisner* ________ 11538 – 11542

Selective High-Resolution Detection of Membrane Protein–Ligand Interaction in Native Membranes Using Trityl–Nitroxide PELDOR

**Trityl, My DEER**: PELDOR can measure distances between spin labels within biomolecules with high precision and accuracy. To investigate hetero-oligomeric protein complexes, a combination of different spin labels is required. Orthogonal spin labeling using a triarylmethyl (TAM) label in combination with a nitroxide label is used to detect protein–ligand interactions in native lipid bilayers.



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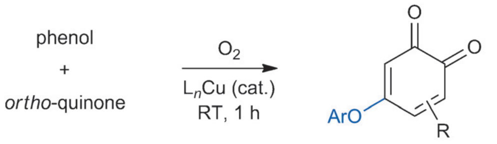
## Copper Catalysis

Z. Huang, J.-P. Lumb* ___ 11543 – 11547

A Catalyst-Controlled Aerobic Coupling of *ortho*-Quinones and Phenols Applied to the Synthesis of Aryl Ethers



- more than 30 examples
- functional-group-compatible
- simple reagents
- decagram scale
- readily diversifiable products

**The reactivity** of *ortho*-quinones can be controlled with copper, and a catalytic aerobic cross-coupling with phenols was developed that provides access to a broad range of aryl ethers under mild conditions. This reaction is a unique example of covalently modifying an *ortho*-quinone in the presence of a transition-metal catalyst, creating new opportunities for their utilization in synthesis.

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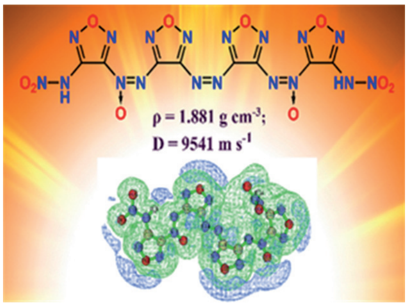
## Energetic Materials

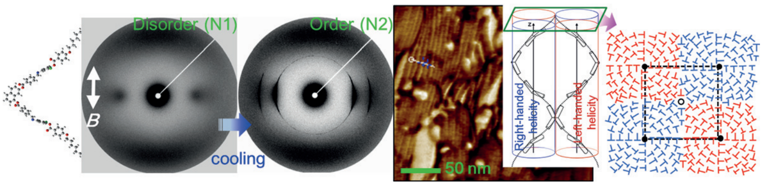
Y. Liu, J. Zhang,* K. Wang, J. Li, Q. Zhang,* J. M. Shreeve* ________ 11548 – 11551

Bis(4-nitraminofurazanyl-3-azoxy)-azofurazan and Derivatives: 1,2,5-Oxadiazole Structures and High-Performance Energetic Materials



**Turn up the heat**: Bis(4-nitraminofurazanyl-3-azoxy)azofurazan and ten derived energetic salts were designed and synthesized. They exhibit ultrahigh heats of formation and excellent detonation performance.

## Liquid Crystals



**Banana**! A distinct mesomorphism of the nematic-to-nematic phase transition is observed with a novel banana-shaped molecule based on a 1,7-naphthalene central core. One model for the anomalous nematic order is given by an analogy of a skyrmion lattice in which two types of cylinders form from left- and right-handed twist-bend helices.

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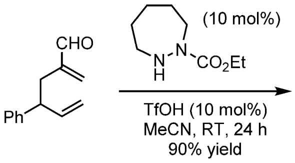
## Organocatalysis



**Seven-membered catalysts**: Diazepane carboxylates catalyze the Cope rearrangement of 1,5-hexadiene-2-carboxaldehydes under mild conditions. This process constitutes the first example of an organocatalytic Cope rearrangement and highlights the efficient formation of α-substituted iminium ions with diazepane carboxylates.

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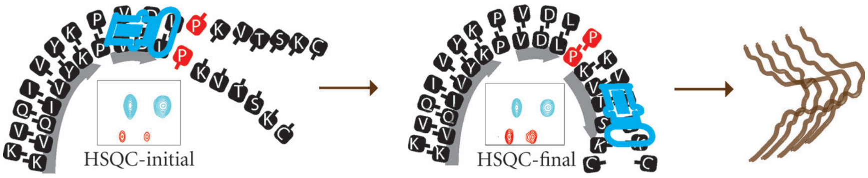
## Protein Aggregation



**Let’s get together**: Structural studies on tau-derived peptides show that the turn conformation upstream of the hexapeptide is critical for the propagation of fibrils under a zipper-like mechanism of association. Aggregation of a mutant tau peptide proceeds through preferential selection of a *cis* peptide bond preceding the amino acid at position 316.

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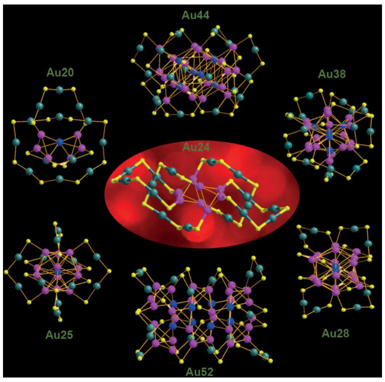
## Nanoparticles

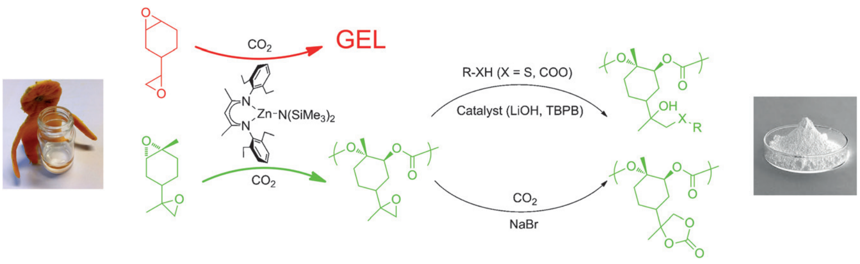
**Three thiolate-protected** gold nanoclusters were synthesized to enable structure–fluorescence relationship studies. The clusters consist of a bi-tetrahedral $Au_8$ kernel protected by four tetrameric $Au_4(SR)_5$ motifs. Their unusual fluorescence is due to two pairs of interlocked $Au_4(SR)_5$ staples and interactions between the kernel and the thiolate motifs.



### Homogeneous Catalysis

C. Li, R. J. Sablong,*
C. E. Koning **11572–11576**

Chemoselective Alternating Copolymerization of Limonene Dioxide and Carbon Dioxide: A New Highly Functional Aliphatic Epoxy Polycarbonate



**From biobased diepoxide to linear epoxy PCs**: A sustainable poly(limonene-8,9-oxide carbonate) was prepared by chemoselective copolymerization of limonene dioxide and CO$_2$. The pendent 2-methyloxiranyl groups along the polymer chain permit the facile post-modification and insertion of CO$_2$ to generate cyclic carbonates as functional side groups.

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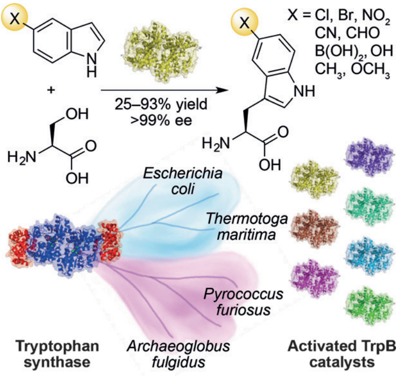
### Biocatalysis

J. Murciano-Calles, D. K. Romney,
S. Brinkmann-Chen, A. R. Buller,
F. H. Arnold* **11577–11581**

A Panel of TrpB Biocatalysts Derived from Tryptophan Synthase through the Transfer of Mutations that Mimic Allosteric Activation



**Better off alone**: The tryptophan synthase enzyme complex is active toward a number of indole analogues. The β-subunit (TrpB) performs the synthetically useful reaction but requires the α-subunit to be fully active. Mutations from a re-activated TrpB variant from *Pyrococcus furiosus* were transferred into homologous TrpB enzymes to generate a panel of stand-alone TrpB catalysts, one of which is useful for making 5-substituted tryptophans, an important biological motif.

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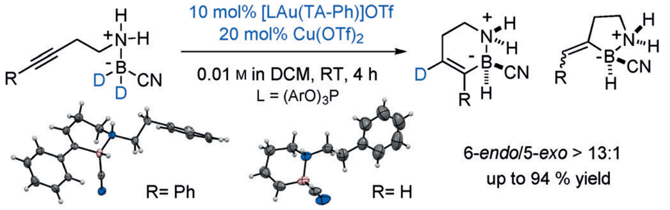
### B,N-Heterocycles

S. E. Motika, Q. Wang, N. G. Akhmedov,
L. Wojtas, X. Shi* **11582–11586**

Regioselective Amine–Borane Cyclization: Towards the Synthesis of 1,2-BN-3-Cyclohexene by Copper-Assisted Triazole/Gold Catalysis



**Golden combo**: The combination of triazole/gold (TA-Au) and copper salts is the optimum catalytic system for intramolecular hydroboration to synthesize six-membered cyclic amine–boranes. Excellent yields and regioselectivities were achieved, and good functional-group tolerance was attained. Deuterium-labeling studies support the involvement of an initial hydride addition to a gold-activated alkyne and subsequent C–B bond formation.

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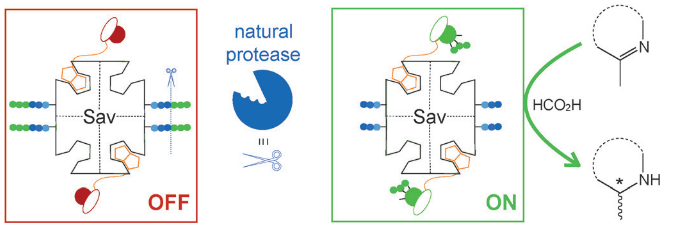
### Artificial Metalloenzymes

Z. Liu, V. Lebrun, T. Kitanosono, H. Mallin,
V. Köhler, D. Häussinger, D. Hilvert,
S. Kobayashi, T. R. Ward* **11587–11590**

Upregulation of an Artificial Zymogen by Proteolysis

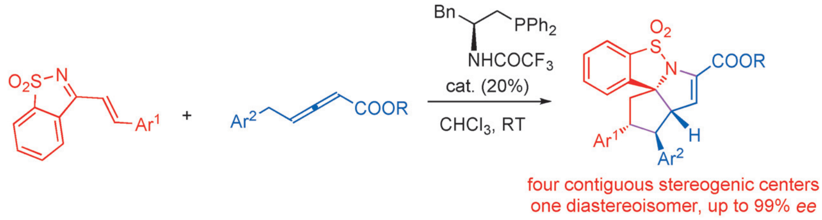


**Cut it on**! An artificial zymogen with latent asymmetric transfer hydrogenase activity was developed and genetically optimized. Its upregulation by a natural protease is demonstrated (see picture; Sav = streptavidin).

## Organocatalysis

E. Li, H. Jin, P. Jia, X. Dong, Y. Huang* ______ 11591 – 11594

Bifunctional-Phosphine-Catalyzed Sequential Annulations of Allenoates and Ketimines: Construction of Functionalized Poly-heterocycle Rings



**A highly stereoselective** sequential annulation reaction between γ-substituted allenoates and ketimines is presented. Using bifunctional *N*-acyl aminophosphine catalysts, poly-heterocycle rings were obtained in good to excellent yields. The desired products have four contiguous stereogenic centers (one quaternary and three tertiary carbon centers), and only one isomer was obtained in all reactions.

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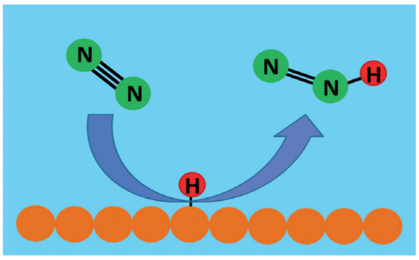
## Surface Dynamics

Y. X. Yao, K. P. Giapis* ___ 11595 – 11599

Direct Hydrogenation of Dinitrogen and Dioxygen via Eley–Rideal Reactions

**Direct atomic hydrogen transfer**: Diatomic molecule collisions with metal surfaces containing D or H adsorbates can lead to the formation of partially hydrogenated transient triatomic states as a first step toward bond activation and rupture. Formation of the elusive $N_2D$ and $O_2D$ intermediates is demonstrated on Pt and Pd surfaces.



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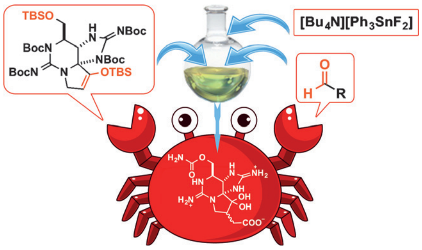
## Natural Product Synthesis

C. Wang, M. Oki, T. Nishikawa, D. Harada, M. Yotsu-Yamashita, K. Nagasawa* ______ 11600 – 11603

Total Synthesis of 11-Saxitoxinethanoic Acid and Evaluation of its Inhibitory Activity on Voltage-Gated Sodium Channels

**At sea**: 11-Saxitoxinethanoic acid (SEA) is a member of the saxitoxin family of paralytic shellfish poisons, and contains an unusual C–C bond at the C11 position. Direct construction the C–C bond at the C11 position of the saxitoxin skeleton involved a Mukaiyama condensation reaction an efficient synthesis of SEA.



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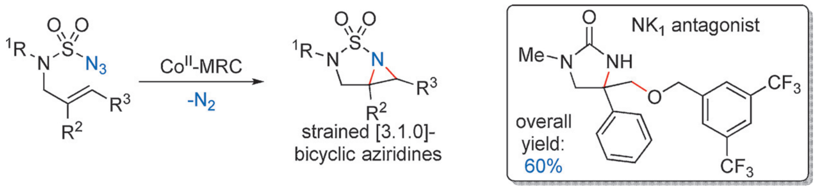
## Heterocycles

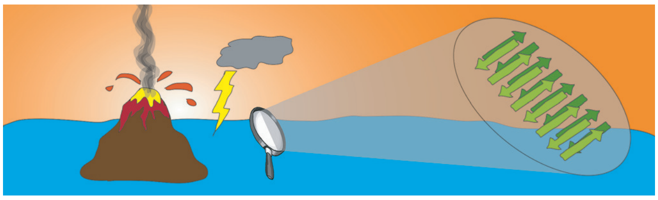
H. Jiang, K. Lang, H. Lu, L. Wojtas, X. P. Zhang* ______ 11604 – 11608

Intramolecular Radical Aziridination of Allylic Sulfamoyl Azides by Cobalt(II)-Based Metalloradical Catalysis: Effective Construction of Strained Heterobicyclic Structures



**Co is key**: Cobalt(II)-based metalloradical catalysis (MRC) delivers highly strained 2-sulfonyl-1,3-diazabicyclo[3.1.0]hexanes by intramolecular radical aziridination of allylic sulfamoyl azides. The aziridines are versatile synthons for the preparation of 1,2- and 1,3-diamines. The metalloradical aziridination reaction was used as a key step for the efficient synthesis of a neurokinin 1 ($NK_1$) antagonist.

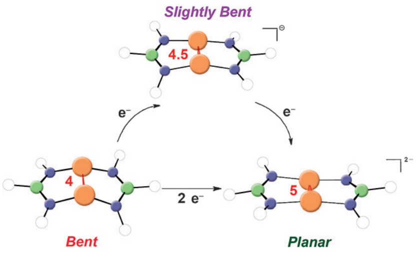
## Prebiotic Chemistry



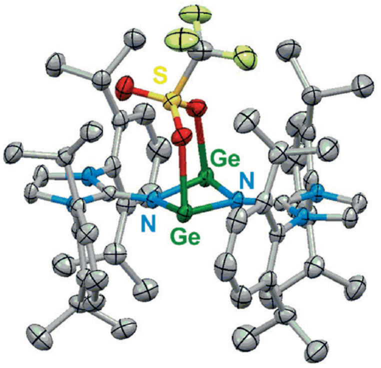
**Once upon a time**: The aqueous synthesis of peptides under conditions that are relevant to a prebiotic earth leads to the formation of ordered amyloid aggregates. With mixtures of four amino acids, such conditions yield thousands of unique peptides that then undergo a spontaneous selection and self-assembly process. The inherent ability of simple peptides to form ordered quaternary structures may be relevant to the origins of biological macromolecules.

## Metal–Metal Bonding

**A quadruply bonded dimolybdenum boraamidinate** with a bent conformation was synthesized and characterized. Subsequent one- and two-electron reduction resulted in an increase in the Mo–Mo bond order to 4.5 and 5, respectively. Distortion of the $Mo_2N_4$ core structures toward planarity is observed as the oxidation states of the $Mo_2$ unit decreases. Key: boron (green), nitrogen (blue), molybdenum (orange).



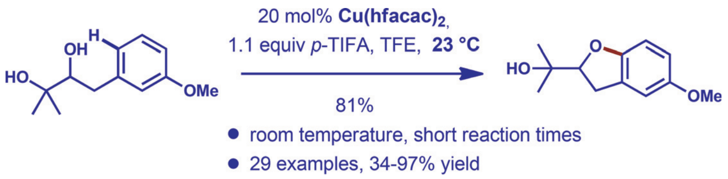
## Structure Elucidation



Germylene-Triflatogermyliumylidene

**Double charge**: A monocationic four-membered germacycle is prepared by fluorination of an amino(imino)-germylene followed by fluoride abstraction. Computational analysis of the bonding situation indicates a dominant germylene-stabilized germyliumylidene character. Its reaction with $Me_3SiOTf$ affords a unique triflate-substituted germylene-germyliumylidene with pronounced dicationic bis(germyliumylidene) character.

## Oxygen Heterocycles

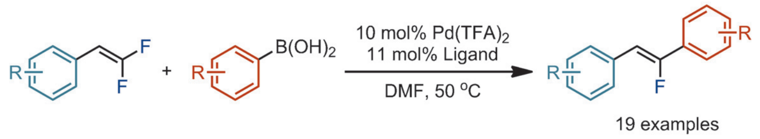


**Take a walk on the mild side**: A method for the synthesis of dihydrobenzofurans minimizing competitive alcohol oxidation is described. The mild reaction conditions are compatible with functional groups not used previously in such transformations. A key step in this process is the in situ formation of an iodonium salt.

## C–C Coupling

R. T. Thornbury,
F. D. Toste* ———— 11629 – 11632

Palladium-Catalyzed Defluorinative Coupling of 1-Aryl-2,2-Difluoroalkenes and Boronic Acids: Stereoselective Synthesis of Monofluorostilbenes



**In neutral**: Monofluorostilbenes were prepared by palladium-catalyzed defluorinative coupling of 1-aryl-2,2-difluoroalkenes with boronic acids. A redox-neutral process via a palladium(II) species that undergoes a β-fluoride elimination to afford the products is proposed. Broad functional-group tolerance arises from the mild reaction conditions and mechanistically distinct reaction manifold. TFA = trifluoroacetate.

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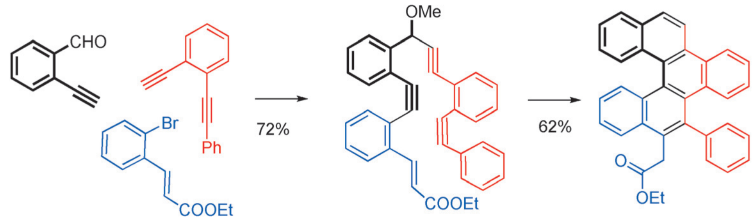
## Polycycles

K. Pati, G. dos Passos Gomes,
I. V. Alabugin* ———— 11633 – 11637

Combining Traceless Directing Groups with Hybridization Control of Radical Reactivity: From Skipped Enynes to Defect-Free Hexagonal Frameworks



**Without a trace**: Oligoalkynes can be converted into polyaromatic polycyclic systems consisting of only six-membered rings. The efficiency and selectivity of this cascade originate from the combination of the $Bu_3Sn$-mediated traceless directing group cascade transformation of skipped alkynes. This strategy opens a new avenue for the controlled preparation of polyaromatic ribbons.

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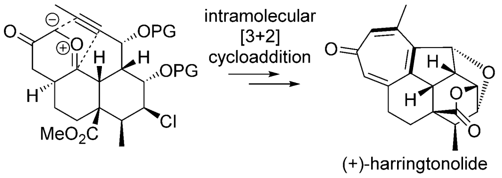
## Natural Product Synthesis

H.-J. Zhang, L. Hu, Z. Ma, R. Li, Z. Zhang, C. Tao, B. Cheng, Y. Li, H. Wang,
H. Zhai* ———— 11638 – 11641

Total Synthesis of the Diterpenoid (+)-Harringtonolide



**Ever more rings**: The first asymmetric total synthesis of the diterpenoid (+)-harringtonolide is described. The key features include an asymmetric transfer hydrogenation, an intramolecular Diels–Alder reaction, chemoselective functionalization of an olefin in the presence of an acetylenic group, a rhodium-catalyzed intramolecular [3+2] cycloaddition, and efficient formation of the tropone.

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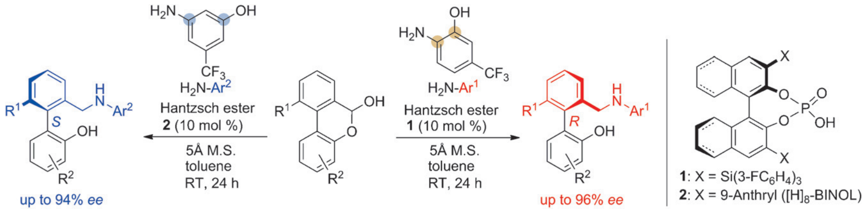
## Biaryls

K. Mori, T. Itakura,
T. Akiyama* ———— 11642 – 11646

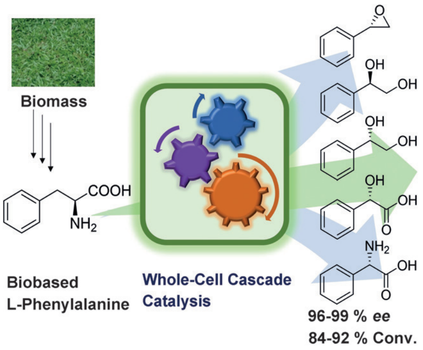
Enantiodivergent Atroposelective Synthesis of Chiral Biaryls by Asymmetric Transfer Hydrogenation: Chiral Phosphoric Acid Catalyzed Dynamic Kinetic Resolution



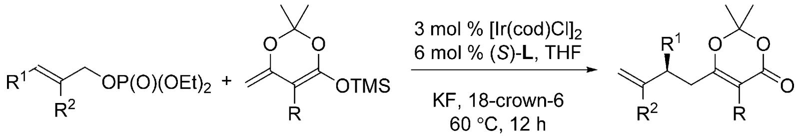
**Divergent**: The title reaction proceeds by a chiral phosphoric acid catalyzed asymmetric transfer hydrogenation reaction. Upon treatment of biaryl lactols with aromatic amines and a Hantzsch ester, in the presence of chiral phosphoric acid, dynamic kinetic resolution by reductive amination reaction proceeds to furnish both *R* and *S* isomers of chiral biaryls by proper choice of a hydroxyaniline derivative. M.S. = molecular sieves.

## Biotransformations

**All fine**: Asymmetric synthesis of a chiral epoxide, diols, a hydroxy acid, and an amino acid in high yield and with excellent *ee* value from biobased L-phenylalanine was achieved with engineered whole-cell biocatalysts containing designed non-natural enzyme cascades, respectively. Fermentative production of the chiral chemicals from glucose was also demonstrated by combining the non-natural cascades with the metabolic pathway of the host.

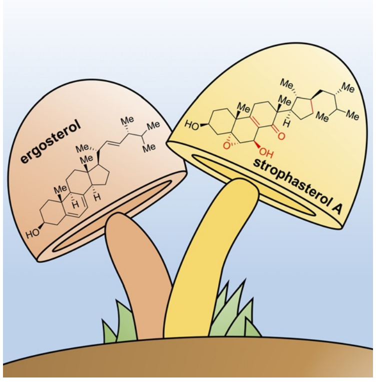


## Asymmetric Synthesis



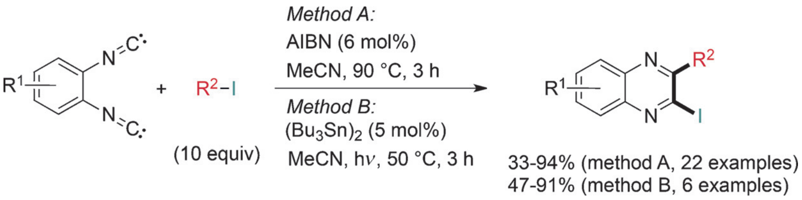
**Branched products preferred**: The first Ir-catalyzed enantioselective allylic substitution of trisubstituted allylic electrophiles has been developed. By employing allylic phosphates as electrophiles, asymmetric allylic substitution of enol silanes derived from dioxinones gave allylated products in good yields with high enantioselectivities.

## Natural Product Synthesis



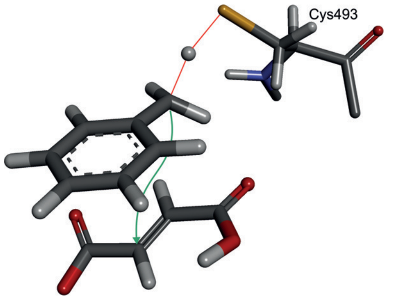
**A tale of two mushrooms**: Starting from the abundant fungal product ergosterol, the first synthesis of the mushroom metabolite strophasterol A was achieved. Novel reactivity was observed en route to this structurally unprecedented moderator of endoplasmatic reticulum stress and should allow analogue design and biological investigations in Alzheimer's disease, as well as providing insight into the biosynthesis of the strophasterol class of natural products.

## Radical Reactions



**Radical cascade reactions**: Diisocyanoarenes react as acceptors with various alkyl iodides in atom transfer radical additions to give alkylated iodoquinoxalines in good to excellent yields. Initiation was achieved thermally with AIBN or under irradiation with visible light.

**Attack from the back**: Radical-based enzymatic addition of fumarate to the methyl group of toluene by benzylsuccinate synthase occurs with inversion of configuration, as shown experimentally by using both enantiomers of chiral toluene. This result is consistent with the predicted structure of a modeled transition-state complex for initial hydrogen abstraction from toluene.



## *Enzyme Catalysis*

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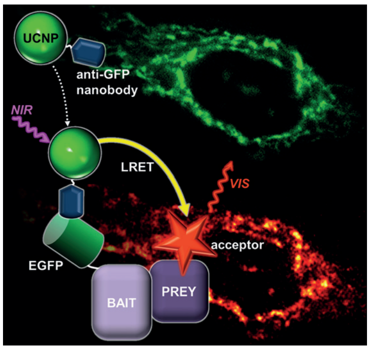

**Within sight**: Upconversion nanoparticles (UCNPs) with tailored photophysical and biofunctional properties were engineered for detecting biomolecular interactions by upconversion lanthanide resonance energy transfer (LRET). Rapid and specific targeting via an anti-GFP nanobody UCNP to EGFP fusion proteins in the mitochondrial outer membrane was achieved.

## *Bioanalytics*

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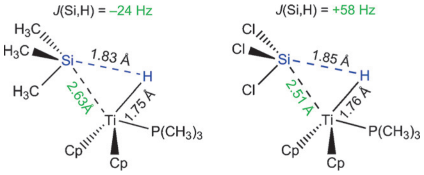
**The sign and magnitude** of $J$(Si,H) coupling constants provide a highly sensitive tool to measure the extent of Si—H bond activation in nonclassical silane complexes. Up to now, this structure–property relationship was obscured by erroneous determinations of the sign of $J$(Si,H) in the literature. These new findings help to identify the salient control parameters of the Si—H bond activation process in nonclassical transition-metal silane complexes.



## *Si—H Bond Activation*

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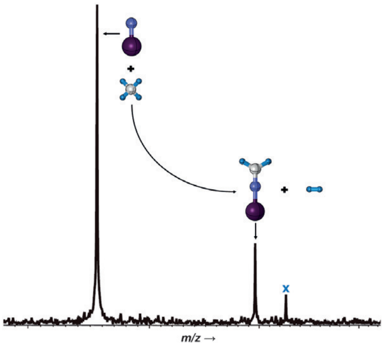
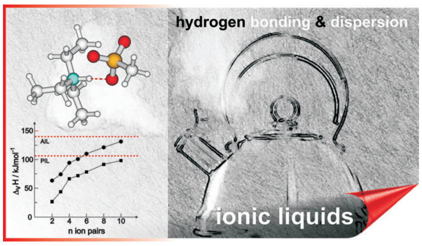
**MeTa-lated**: Thermal activation of methane by $[TaN]^+$ under C—N coupling and formation of $H_2$ was detected by mass spectrometry and confirmed by quantum chemical calculations. The lighter congeners $[VN]^+$ and $[NbN]^+$ are inert towards methane under the same conditions. (In the picture the signal labeled with "×" arises from reactions with background contaminants.)



## *Gas-Phase Reactions*

## Ionic Liquids

**Against all expectations**, the vaporization enthalpies of protic ionic liquids (PILs) are lower than those of aprotic ionic liquids (AILs). The explanation: Substantial hydrogen bonding and dispersion forces within the ion pairs are transferred into the gas phase, resulting in relatively low vaporization enthalpies for PILs. Experiments and calculations point out the relevance of weak forces in ILs.



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