Identifying Single Nucleotides by Tunnelling Current

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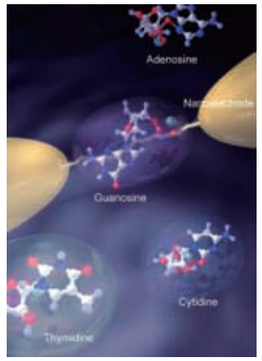
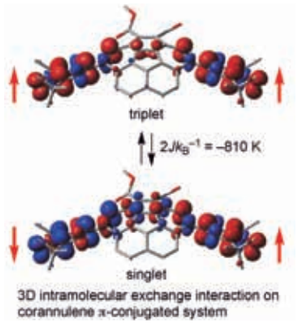
It has been proposed theoretically that reading the transverse tunneling current through a DNA molecule with the embedded electrodes enables sequencing of DNA translocating the nanopore. This new detection paradigm will revolutionize the present DNA sequencing capability. However, it still lacks experimental verifications. Here, we report direct current measurements through single nucleotide molecules residing in a pair of nanoelectrodes. We find linear current-voltage characteristics suggestive of electron tunneling transport in electrode-(single nucleotide)-electrode systems. We also demonstrate clear statistical discrimination of single nucleotides via the energy gap related tunneling currents, thereby providing essential scientific basis for the emerging DNA sequencing technology.



Three-Dimensional Intramolecular Exchange Interaction in a Curved and Nonalternant π-Conjugated System: Corannulene with Two Phenoxyl Radicals

Ueda, A.; Nishida, S.; Fukui, K.; Ise, T.; Shiomi, D.; Sato, K.; Takui, T.; ***Nakasuji, K.***; ***Morita, Y.***
(Graduate School of Science)

Angewandte Chemie International Edition, **49**, 1678–1682 (2010)



A neutral diradical based on corannulene with curved and nonalternant π conjugation has been synthesized and isolated as air-stable crystals. Thanks to the high stability and the sizable spin delocalization onto the corannulene skeleton from the radical moieties, we have experimentally revealed, for the first time, the occurrence of 3D intramolecular exchange interaction via the curved and nonalternant π-conjugated system of corannulene. Furthermore, we have successfully illustrated that the magnitude of the intramolecular exchange interaction is enhanced by decreasing the curvature of the corannulene skeleton. These findings demonstrate the intriguing aspects of a 3D intramolecular exchange interaction of neutral diradical systems having curved and nonalternant π-conjugated networks. (106 words)

▲From ***Angewandte Chemie International Edition,*** 49, Morita, Y. et al., Three-Dimensional Intramolecular Exchange Interaction in a Curved and Nonalternant π-Conjugated System: Corannulene with Two Phenoxyl Radicals, 1678-1682, 2010. Copyright Wiley-VCH Verlag GmbH & Co. KGaA. Reproduced with permission.

Sub-Å Resolution Electron Density Analysis of the Surface of the Organic Rubrene Crystals

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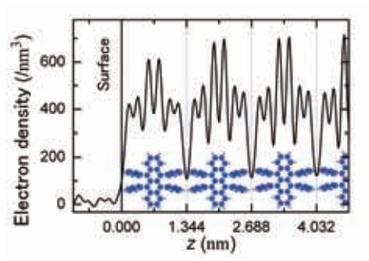
Physical Review Letters, **104**, 066103-1-4 (2010)

Near surface electron density distribution of an organic semiconductor is firstly observed by a combination of a synchrotron x-ray diffraction experiment and a new holographic method of analysis. The observed electron density profile of a rubrene single crystal, which is known as a high-mobility organic transistor material, shows a large positional distribution of the molecules at the first layer. Since the conduction path of the electric current in a transistor is confined to the vicinity of the surface of the crystal, the surface structure is highly important to elucidate the physics of the organic transistor microscopically.



Conformational Change of Flagellin for Polymorphic Supercoiling of the Flagellar Filament

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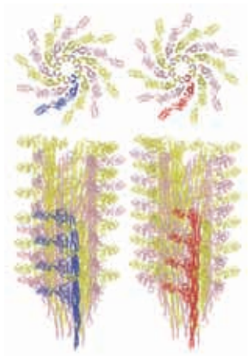
(Graduate School of Frontier Biosciences)

Nature Structural & Molecular Biology, **17**, 417-422 (2010)



The bacterial flagellar filament is a helical propeller rotated by the flagellar motor for bacterial locomotion. The filament is a supercoiled assembly of a protein, flagellin. The reversal of motor rotation switches the supercoil between left- and right-handed by changing the ratio of two distinct protofilament conformations called L-type and R-type. We analyzed the structure of the L-type straight filament by electron cryomicroscopy and compared with the R-type and found that the orientation and packing of the outer core domains (D1) against the inner ones (D0) are invariant and that a conformational switching of D1 with flexibility of D0 and D1 play important roles.

Two-Dimensional Crystal Engineering; A Four Component Architecture at a Liquid-Solid Interface

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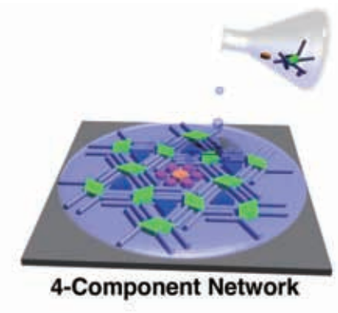
A four-component 2D crystal has been formed at a liquid-solid interface and successfully visualized by scanning tunneling microscopy. Simply premixing the four components and applying the solution onto the graphite surface leads to the spontaneous self-assembly of the 2D crystal. Selected guest molecules induce a structural transformation of the host network from nonporous to porous by coadsorption inside the formed pores.



▲From ***Angewandte Chemie International Edition,*** 48, Tahara, K. et al., Two-Dimensional Crystal Engineering: A Four-Component Architecture at a Liquid-Solid Interface, 7353-7357, 2009. Copyright Wiley-VCH Verlag GmbH & Co. KGaA. Reproduced with permission.

Ion Segregation and Deliquescence of Alkali Halide Nanocrystals on SiO_2

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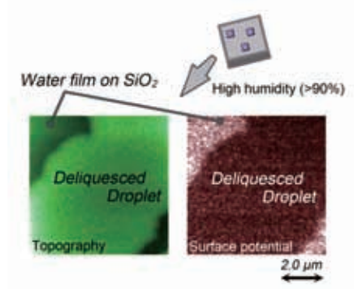
The Journal of Physical Chemistry A, **113**, 9715-9720 (2009)



Reactions at the air/aqueous solution interface have attracted attention because of relevance to atmospheric chemical processes. The adsorption of water on alkali halide nanocrystals on SiO_2 and their deliquescence is investigated in the entire range of relative humidity (RH) by scanning polarization force microscopy. At low RH, water adsorption solvates ions at the surface of the crystals, which results in a large increase in the dielectric constant. For KBr, KCl and NaCl, deliquesced droplets at high RH exhibit a negative surface potential relative to the surrounding region, which is indicative of preferential segregation of anions to the air/solution interface.

Unusually Large Tunneling Effect on Highly Efficient Generation of Hydrogen and Hydrogen Isotopes in pH-Selective Decomposition of Formic Acid Catalyzed by a Heterodinuclear Iridium-Ruthenium Complex in Water

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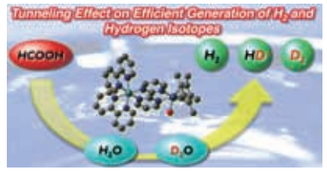
(Graduate School of Engineering)

Journal of the American Chemical Society, **132**, 1496-1497 (2010)



Hydrogen has attracted much attention as an alternative clean energy, because the reaction of hydrogen with oxygen produces the requested energy and only water as an environmentally friendly side product. However, the storage and transfer of hydrogen are difficult with current technology, because hydrogen gas is explosive with a poor volumetric energy density. In this context, the interconversion of H_2 with CO_2 to formic acid (HCOOH) in the presence of an appropriate catalyst has merited special attention. This study provides the most effective catalyst for the pH-selective hydrogen production from formic acid ever reported and also the first example to show a large tunneling effect on the hydrogen production in water.

Controlled Fabrication of Epitaxial $(Fe,Mn)_3O_4$ Artificial Nanowire Structures and their Electric and Magnetic Properties

Goto, K.; ***Tanaka, H.***; ***Kawai, T.***
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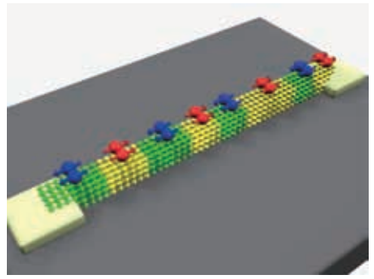
Nano Letters, **9**, 1962–1966 (2009)



The combination of scale reduction and the use of materials exhibiting important properties - such as ferromagnetic oxides - is particularly promising. Novel strategy for fabricating artificial nanowires of functional oxide with tight control of length and width, and location was reported, in combination of atomic force microscope lithography and pulsed laser deposition technique. The successful control of the dimensions of the nanowires down to 100nm was also confirmed by measurements of their electrical and magnetic properties. These results are particularly important for applications based on transition-metal oxides, for which the control of shape and position is indispensable for realizing nano-oxide devices.