

The Thermosalient Phenomenon. "Jumping Crystals" and Crystal Chemistry of the Anticholinergic Agent Oxitropium Bromide

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The **thermosalient effect**, colloquially also referred to as "jumping crystals" is an extremely rarely observed, albeit very important phenomenon. When heated or cooled, crystals of some materials can jump about several centimeters high as a result of the colossal mechanical strain that develops in their structures. Although this property is very prospective for fabrication of **actuators** for conversion of heat into mechanical work, its mechanism has remained unexplained. In this work, we found that each jumping molecule can be regarded as "**molecular shuttle**", where two rigid fragments are connected by a flexible linker that acts as mechanical spring.

When the mechanical stress is relieved, the crystals can jump (highlighted in *Nature Chemistry*, 2 1003 (2010); *Crystal Growth & Design*, <https://communities.acs.org/docs/DOC-3662>).



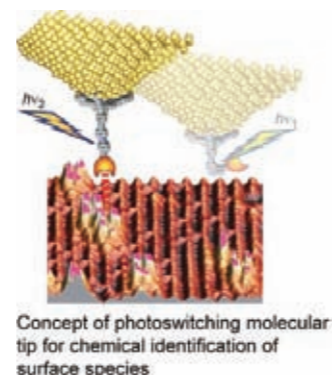
Photoswitching Tripodal Single Molecular Tip for Noncontact AFM Measurements: Synthesis, Immobilization, and Reversible Configurational Change on Gold Surface

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Organic & Biomolecular Chemistry, **8**, 3655-3664 (2010)

Tripodal molecules consisting of a tetrasubstituted adamantane with three phenylacetylene legs and a reversibly photoswitching apex were designed as "single molecular tips" for both chemical and topographical characterization of the substrate surface. By covalent attachment onto gold-coated tips of atomic force microscopy (AFM) through three S-Au bonds, these rigid tripodal molecules are expected to act as sharp, robust, and stationary molecular tips whose configuration can be reversibly changed upon irradiation with UV or visible light. In this report, the full account of the syntheses of two photoswitching tripodal molecular tips, their immobilization onto Au(111) surfaces, and the detection of photoinduced configurational change on Au(111) surface by scan-

ning probe microscopy (SPM) measurements are documented.



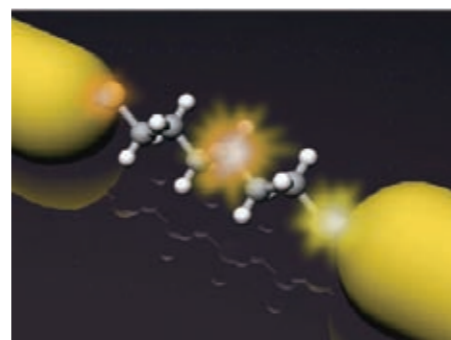
Single Molecule Identification via Electric Current Noise

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Nature Communications, **1**, 138-142 (2010)

We find that inelastic noise in a single-molecule tunneling junction increases in a stepwise fashion synchronous to the onsets of inelastic excitations of its distinct vibrational modes active in the electron-phonon interaction, which thereby enable single-molecule fingerprinting through examining the noise spectra. We are also able to identify the electron-phonon coupling strength and the symmetry of a single organic molecule from the distinct noise characteristics. As electron-vibration interactions exist in virtually any types of molecules, these findings suggest a potential use of inelastic noise as a useful molecular signature for single-molecule identifications

with high specificity that may open new venues for practical realization of single-molecule sensors.



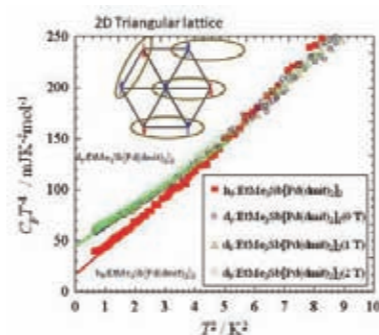
Gapless Spin Liquid of an Organic Triangular Compound Evidence by Thermodynamic Measurements

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Nature Communications, **2**, 275 (2011)

We investigated thermodynamic properties of an anion radical spin-liquid compound of $\text{EtMe}_3\text{Sb}[\text{Pd}(\text{dmit})_2]_2$, where dmit represents 1,3-dithiole-2-thione-4,5-dithiolate. This compound is an organic dimer based Mott insulator with a two-dimensional triangular lattice structure of $S=1/2$. We observed a distinct evidence for the formation of gapless spin-liquid by measuring C_p under magnetic fields up to 8 T. Through comparative analyses with κ -(BEDT-TTF) $_2\text{Cu}_2(\text{CN})_3$ using the Wilson ratio, the electronic heat capacity coefficient was found to be in proportion to the magnetic susceptibility, as in the case of Fermi liquid systems. Furthermore, anomalous enhancement of

γ due to a kind of criticality inherent in the $\text{Pd}(\text{dmit})_2$ phase diagram is also discussed in the paper.



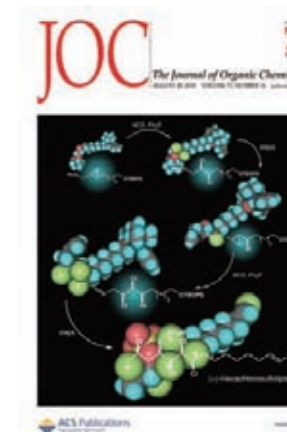
Asymmetric Total Synthesis of (+)-Hexachlorosulfolipid, a Cytotoxin Isolated from Adriatic Mussels

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The Journal of Organic Chemistry, **75**, 5425-5437 (2010)

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Outbreaks of shellfish poisoning are a worldwide threat to public health. Marine toxins, often produced by microalgae, have been implicated as the causative factors of these events. Recent studies on toxic mussels have led to the discovery of chlorosulfolipids, a new class of natural toxins. In the quest for deeper knowledge of these lipid toxins, we embarked on a research program to establish chemical access to chlorosulfolipids. The picture depicts a chemical route to a polychlorosulfolipid that features an epoxy-deoxydichlorination methodology allowing us to make the complex chlorinated molecular architecture. Using this new method, (+)-hexachlorosulfolipid, a natural toxin found in the Adriatic mussel, has been successfully synthesized.



Mechanism of Variable Structural Colour in the Neon Tetra: Quantitative Evaluation of the Venetian Blind Model

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Journal of the Royal Society Interface, **8**, 56-66(2011)

A small tropical fish, the neon tetra, is one of the distinctive examples of structural colour found in nature, which is produced by microstructures in submicron size. It is quite interesting that the neon tetra can change its colour in the lateral stripe from violet to yellow-green depending on the light intensity of the surrounding environment. Such a tunable optical property is expected in various types of applications in optics. In order to clarify the colour variation mechanism of the neon tetra, we prepared a new optical system using a microscope that can simultaneously measure both the spectrum and direction of the reflected light. It was confirmed that Venetian blind mechanism quantitatively explains the optical properties during the colour change.



Engineering

Direct Observation of the Coalescence Process between Nanoscale Dislocation Loops with Different Burgers Vectors

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Acta Materialia, **59**, 141-145 (2011)

Dynamic behavior of nanoscale prismatic dislocation loops can significantly affect the microstructural variation in crystalline materials upon processes such as plastic deformation and high-energy particle irradiation. By using in situ transmission electron microscopy, we have experimentally examined a reaction following the collision between two dislocation loops with different Burgers vectors in alpha-iron. Even after the formation of the junction, the reaction progressed further, unlike conventional reactions between dislocations of macroscopic length. The junction moved toward the far end of the smaller loop and finally formed a single loop, which in essence was the absorption of the smaller loop by the larger loop.

