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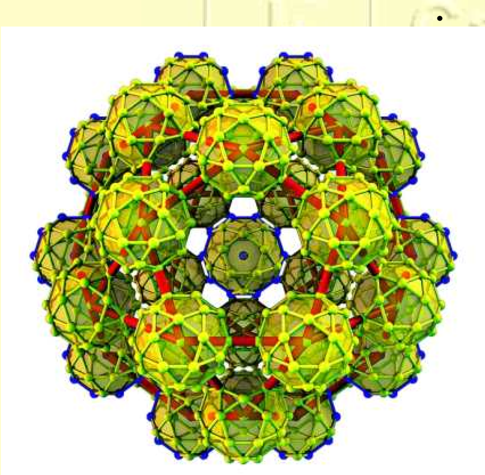
Els quasicristalls mereixen el Nobel

For the discovery of a new class of materials, known as quasicrystals, Dan Shechtman, a professor of materials science at Technion–Israel Institute of Technology, has been awarded the 2011 Nobel Prize in Chemistry. His pathbreaking work on crystallinity, greeted initially with derision and skepticism, came to upend basic notions in science about the atomic structure of matter. While examining aluminum alloys in an electron microscope in 1982, Shechtman recorded diffraction patterns with 10-fold rotational symmetries—a condition that conventional wisdom in the field of crystallography held as impossible. Unlike ordinary crystals, the materials that Shechtman was studying lacked periodicity, meaning their atomic structure could not be depicted by a geometric pattern of atoms that repeats in three dimensions at fixed intervals. Nonetheless, they were ordered crystals—sort of. Shechtman showed that these specimens were oddly ordered materials, which later came to be known as quasicrystals. The class of materials includes a large number of multicomponent alloys that often exhibit five- or 10-fold rotational symmetry, a condition that's forbidden in conventional crystallography. The very definition of crystallinity included periodicity of the crystal structure. His work showing that this is not always the case redefined crystallinity. Ever since Shechtman's discovery, quasicrystals have sparked debate over atomic structure, stability, and other basic science issues.

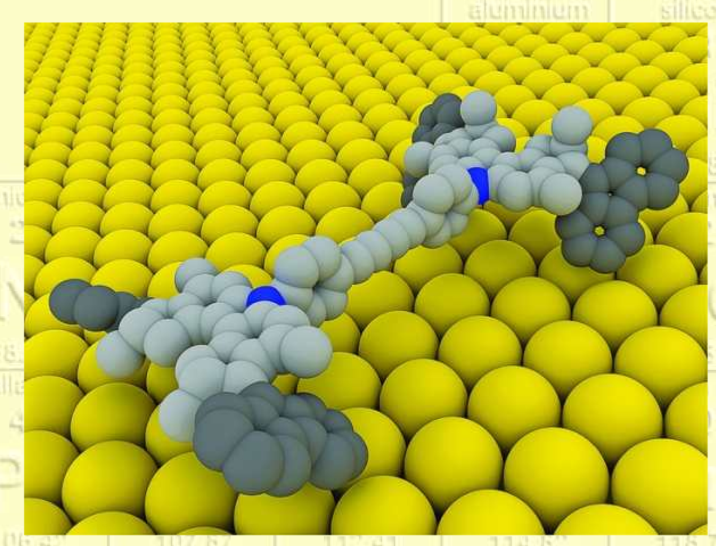


An icosahedral Yb-Cd quasicrystal is composed of an aperiodic ordered arrangement of YbCd clusters (yellow and blue spheres at the vertices of the polyhedra).

Daniel Shechtman (Tel Aviv, 1941)

Un nanotot terreny elèctric

A new electric car is driving off the lot. Because it's only a few nanometers long and operates at a chilly 7 K, this little automobile is unlikely to cause any sleepless nights for electric car makers. Even so, it's pretty souped-up as nanocars go, boasting four molecular motor moieties that propel the tiny vehicle along a copper surface with a paddle wheel motion (Ben L. Feringa et al. *Nature*, **2011,** *479*, 208). Previous nanocars either simply diffused along a surface or had to be towed by the tip of a scanning tunneling microscope (STM). This new single-molecule coupe moves when an STM tip fires electrons at it, prompting isomerization of the double bonds in its molecular motor "wheels." The unidirectional motors combined with their stereochemical arrangement on the molecule make the nanocar putt-putt along. With 10 shots from the STM, the nanocar moves 6 nm forward. The driving force behind the project was the desire to figure out how to get an entirely synthetic, single-molecule system to move on its own



A model of a single-molecule car that can advance across a copper surface whenelectronically excited by an STM tip.

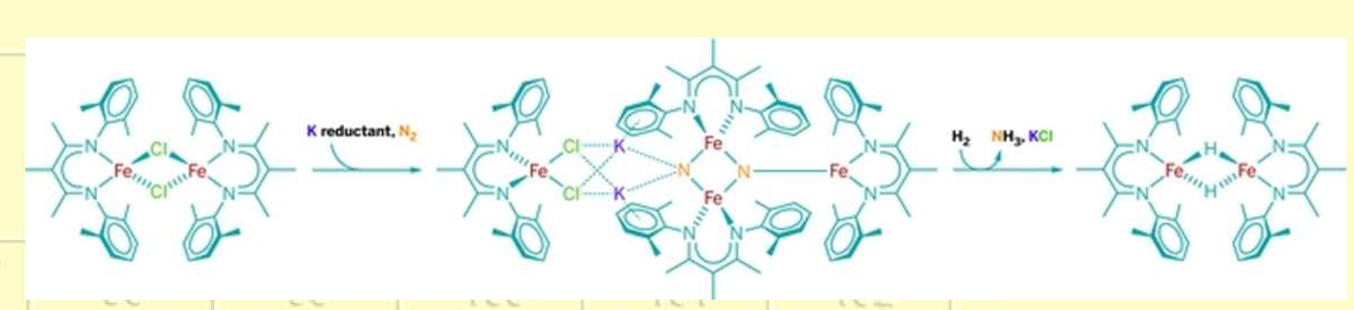
100.000 anys fent química!

Bright yellow and red iron oxides known as ochre found in deposits on Earth have long been used as pigments—for example, by early humans to paint their bodies and other objects. Now, archaeologists have discovered a 100,000-year-old ochre-processing workshop in a South African coastal cave, the oldest such site, by 40,000 years, found to date (Christopher S. Henshilwood et al. Science, **2011**, *334*, 219). Discoveries at the cave document early humanity's "deliberate planning, production, and curation of a pigmented compound and the use of containers," notes the research team. "Homo sapiens [of that era] thus also had an elementary knowledge of chemistry and the ability for long-term planning," the researchers conclude. The team uncovered evidence that these early humans ground the ochre from rock and heated bones to extract fat and marrow that were then used as a binder for the pigments. Charcoal was also sometimes added to the mixture. The ancient paint was then placed in sealed abalone shells for storage.

Paleolithic "chemists" used this abalone shell to store paints made from ochre.

Haber-Bosch emulat

An iron complex that can turn dinitrogen and dihydrogen into ammonia provides long-sought mechanistic clues as to how the Haber-Bosch process produces NH_3 industrially (Patrick L. Holland et al. *Science*, **2011,** *334*, 780). Fritz Haber and Carl Bosch developed the process to make ammonia from N_2 and H_2 in the early 1900s. The reaction can be catalyzed by a number of different metals, but the most common is iron with potassium added as a promoter. Studies of that system show that the iron surface chemisorbs N_2, with the N-N triple bond cleaving to give surface-bound nitride (N^{3-}). But key mechanistic details have remained unclear. Model complexes could provide insight, but until now no one had been able to reproduce the reaction using iron. The new complex is an Fe(II) β-diketiminate chloride compound in which two Fe(II) atoms are bridged by two chloride ions. Two of these Fe(II) complexes react with N_2 and potassium graphite, a strong reductant, to produce a four-iron bis(nitride) complex. In the bis(nitride) complex, one nitride is bound to two Fe(III) and one Fe(II) ions. The other nitride is bound to the same two Fe(III) ions and the fourth iron, an Fe(II) ion, through bridging potassium and chloride ions. Adding hydrogen to the bis(nitride) complex results in NH_3 formation with 42% yield. Unlike the Haber-Bosch system, the new complex is not catalytic. Aside from NH_3, the reaction produces an Fe(II) β-diketiminate hydride compound that does not repeat the chemistry.



An Fe(II) β-diketiminate chloride compound reacts with N_2 to form a bis(nitride) complex, which further reacts with H_2 to produce NH_3.

Any Internacional de la Química 2011

• **Avui recomanem**, dues noves Taules Periòdiques creades per artistes d'estils i tècniques molt diferents. Una, publicada per la Royal Australian Chemical Institute (www.raci.org.au/periodic-table-on-show) i l'altra pel Printmaking Project (www.azuregrackle.com/periodictable/table). Cada casella, a més d'una breu informació sobre l'element, conté una descripció de com l'artista ha interpretat l'element.

Breus

• El Consell Social de la UB ha atorgat el Premi Ramon Margalef 2011 al millor treball derivat d'una tesi doctoral a Jorge Echeverría del Departament de Química Inorgànica. L'article, publicat a *Nature Chemistry*, **2011**, *3*, 323, és un estudi teòric de les interaccions intermoleculars d'hidrogen en alcans i poliedrans.

• Per primera vegada s'ha detectat que el forat d'ozó a l'Àrtic és comparable al de l'Antàrtic. El fet sembla ser degut a un període de fred intens més llarg, que ha afavorit la formació de núvols estratosfèrics sobre els que es produeix la reacció de formació d'ozó a partir d'espècies que contenen Cl. *Nature*, **2011**, *478*, 469.

• S'ha observat que les gotes de diclorometà agafen formes geomètriques diferents com cercles i diversos polígons, quan es dissolen en solucions aquoses de sals d'amoni quaternari. *Angew. Chem*., **2011,** *50*, 10728.

L'element

El lantani, element número57, fou descobert pel químic suec CarlGustav Mosander l'any 1839, en una impuresa del $Ce(NO_3)_3$. El seu nom ve del grec lanthaneîn, λανθανεν,que vol dir amagat.
És l'element que dóna nom al grup dels lantànids constituït pel mateix lantani i els 14 elements que apareixen enomplir-se els orbitals 4f; forma part, també, de les terres rares, grup que a més dels lantànids comprèn Sc i Y; són elements que es troben tots ells en els mateixos minerals –principalment la monazita, $LnPO_4$, – tenen unes propietats molt semblants i és molt difícil de separar-los. A pesar del nom (terres rares) són elements relativament abundants a la terra i l'adjectiu rar té raons històriques en comparar-ne l'abundància amb la d'altres terres (òxids) com la calç i la magnèsia.Té diferents aplicacions en el camp de l'electrònica i les noves tecnologies, en particular en la fabricació de fibres òptiques. El seu futur és prometedor, ja que és un component de les bateries de níquel / hidrurs metàl·lics que porten els cotxes híbrids.