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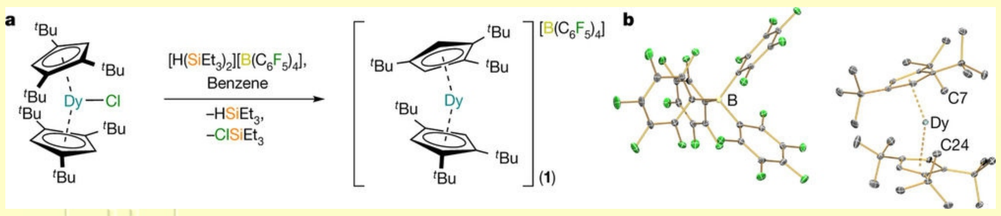
Un número de rècords!

El millor imant molecular

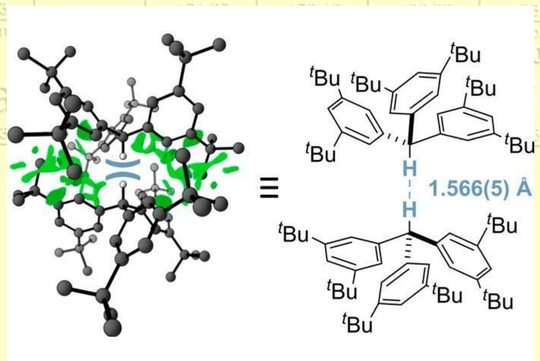
The quest to develop smaller and more energy efficient smartphones and supercomputers with more features and processing power hinges on increasing data storage capacity. A dysprosium molecule with switchable magnetic properties, a single-molecule magnet (SMM) with the ability to store a single bit of data, has been reported, simultaneously for two research groups of the University of Manchester! (R.A. Layfield et al., *Angew. Chem.* **2017**; DOI:10.1002/anie.201705426. D.P. Mills, et al., *Nature*, **2017**;DOI:10.1038/nature23447). The new dysprosium molecule displays magnetic switchability up to 60 K, which is tantalizingly close to 77 K, liquid nitrogen's temperature, which would make SMMs commercially practical for data servers. SMMs could handle about 30 terabits of data per square centimeter, or more than 25,000 GB of information on a device the size of a flash drive. That greatly exceeds the 256-GB data storage of today's basic flash drives or Apple's latest iPhone 7 that rely on magnetic nanoparticles.



a, Synthesis of 1. b, Molecular structure of 1 with selective atom labelling (B, yellow; C, grey; Dy, cyan; F, green). Displacement ellipsoids set at the 30% probability level and hydrogen atoms are omitted for clarity.

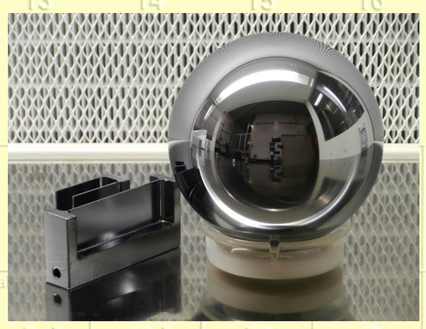
Els hidrògens més pròxims

The shortest interaction ever seen between hydrogen atoms bound to neighbouring molecules has been discovered (S. Rösel et al., *J. Am. Chem Soc.*, **2017**; DOI:10.1021/jacs.7b01879). Chemists routinely draw lines between individual atoms to represent chemical bonds. However, chemical interactions are less static than these solid, dashed or dotted lines might imply, bonds can be twisted, stretched or compressed, depending on the molecules' geometry. The team has discovered that tri(3,5-tert-butylphenyl)methane crystallises to form the shortest intermolecular hydrogen–hydrogen interaction. Neutron diffraction revealed that the molecule forms dimers, squeezing the central hydrogen distance to only 1.566Å. This H···H distance beats the previous record holder of 32 years by 0.051Å. The discovery is an unusual case as the interaction occurs between hydrogens sitting on adjacent molecules rather than within the same structure, usually ultra-short H···H distances are only possible in sterically hindered, cage- or bowl-shaped molecules.



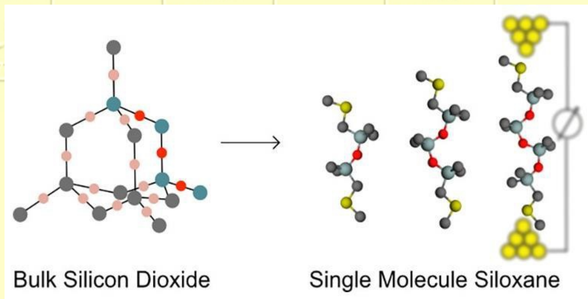
El silici més pur

The perfect sphere that will be used to redefine the kilogram in terms of the Planck constant in 2018 has been shown to consist of the purest silicon ever made. The kilogram is the only unit still based on a physical object. The International Committee for Weights and Measures decided to redefine the unit using the Planck constant. This fundamental physical constant relates to mass through Einstein's formula E = mc2 .One way to calculate Planck's constant involves determining Avogadro's constant. To do this, scientists will calculate the atoms in a silicon sphere, but this only works if the crystal is free of impurities. A sample of the sphere for 65 elemental impurities using neutron activation analysis, has been checked. The 'largest' impurity found was copper, approximately 70 nanograms per gram of sample. This adds up to about one copper atom for every three billion silicon atoms. Other elements were found in even tinier amounts – picograms to femtograms per gram of silico– including chromium, cobalt, gallium, arsenic, bromine, lanthanum, tungsten and gold. The researchers found no traces of any of the other elements, down to their detection limits.With all the impurities accounted for, 1kg of the material would weigh 0.7µg less than it should if every atom were silicon. (M. i Luzio et al., Anal. Chem., **2017**; DOI:10.1021/acs.analchem.7b01957)



... i el pitjor conductor

A new type of molecular wire –formed from repeat units of silicon and oxygen– has been found to demonstrate the greatest resistance ever recorded, making them ideal insulators for molecular circuits. In order for nanoscale electronics to progress, it requires both conductors and insulators. Traditionally, most research has focused on the development of increasingly efficient conductors. However, other researchers have managed to develop the most insulating nanoscale material to date, siloxane wires. (L. Haixing et al., *J. Am. Chem. Soc.*, **2017**; DOI: 10.1021/jacs.7b05599).The conductance of the molecular wires, each a single molecule thick and up to 20Å long, was determined using the scanning tunnelling microscope-based break-junction method. When compared to alkanes, the prototypical molecular insulator, and silanes of the same length, siloxane wires were found to have a lower conductance than both.



Breus

- Mètodes d'análisi de pol·luents atmosfèrics, basats en l'efecte fotoacústic, han arribat a un nivell de detecció de l'ordre d'1 en mil bilions, (G. Dielbod et al., *Proc. Natl. Acad. Sci. USA*, **2017**; DOI: 10.1073/pnas.1706040114).
- Es fabriquen espectròmetres de RMN de camps ultra-alts, 1.2 Ghz (28.2T), capaços d'assolir una homogeneïtat del 99.99999999% en una zona d'1 cm^3. De moment, el preu és de l'ordre de 12.5 milions €. (H. Schwalbe, *Angew. Chem. Int. Ed.*, **2017**, 56 1052-1053; DOI: 10.1002/anie.201705936).
- S'ha proposat una escala absolua d'acidesa de solvents de 28 ordres de magnitud, el doble de l'escala de pH clàssica. (E. Paernuk et al., *Chem Sci.*, **2017**; DOI: 10.1039/c7sc01424d).

Avui recomanem

L'impactant article «¿Son los vertiginosos beneficios de la industria editorial malos para la ciencia? (http://www.sinpermiso.info/textos/son-los-vertiginosos-beneficios-de-la-industria-editorial-malos-para-la-ciencia) publicat en el diari britànic *The Guardian* (https://www.theguardian.com/science/2017/jun/27/profitable-business-scientific-publishing-bad-for-science 2/), en què s'analitza de manera clara i crítica el paper -comparable al de les comissions bancàries- de les editorials científiques.

L'element

L'element número 80, **mercuri,** és conegut des de l'antiguitat, i el vermelló (cinabri), s'ha trobat en pintures paleolítiques en coves a la vora d'Almadén. La mostra de mercuri més antiga coneguda es va trobar en un receptacle egipci del 1600 aC. El seu nom prové del planeta "mercuri" i el símbol del terme llatí *hydrargyrum* , que vol dir argent viu. Els alquimistes el consideraven un material únic, de fet era "l'element", a partir del qual es formaven tots els metalls i, per tant, imprescindible en la transmutació en or.

És un element molt poc abundant a la terra, i el principal mineral n'és el cinabri, (HgS). Els jaciments més importants es troben a Almadén –que ja era explotat pels romans i fins la dècada de 1970 se n'havien extret unes 200.000 Tm–, Rússia i Xina. La producció anual ha anant disminuint de manera molt significativa; l'any 2013 fou d'unes 2000 Tm, sent la Xina el principal país productor. Les seves aplicacions són cada cop més limitades, actualment s'empra en termòmetres per determinar temperatures altes i, de moment, en làmpades fluorescents. No té cap paper biològic encara que es troba present en tots els éssers vius, atesa la seva volatilitat i la del seus compostos organometàl·lics –formats per microorganismes– que el fan present en l'atmosfera. A pesar de la seva toxicitat ha estat emprat tradicionalment en medicina, com a laxant, diürètic, desinfectant, etc. Avui dia els efectes tòxics són pràcticament nuls per les estrictes normes de seguretat establertes.