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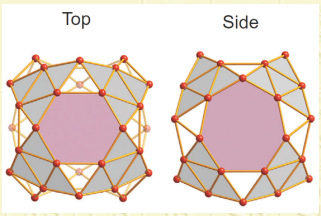
Els gasos nobles agents dopants!

The **World Anti-Doping Agency** (*www.wada-ama.org*), which governs international drug testing for competitive athletes, has added the noble gases xenon and argon to its List of Prohibited Substances & Methods. It's hard to imagine how the essentially chemically inert gaseous elements could improve athletic performance. But xenon is surprisingly bioactive and can enhance the oxygen-carrying capacity of blood. Argon is thought to work the same way. Xenon is known to interact with protein receptors and ion channels and function as a hypoxia-inducible factor (HIF), similar to nitrous oxide (laughing gas). When it comes to improving athletic performance, xenon is one of several agents known to activate production of HIF-1α, a protein alarm that triggers other proteins to come to the rescue of tissues deprived of oxygen. One of those secondary proteins is erythropoietin (EPO), a hormone that encourages the formation of red blood cells. Synthetic EPO is used for treating anemia in patients with cancer and kidney disease, but it is infamous as a banned performance-enhancing drug, especially among endurance athletes such as cyclists. Athletes have turned to inhaling xenon in the same way they might train in low-oxygen conditions at high altitude. Xenon and argon clear from the body within hours, but the performance-enhancing effects can last several days. The agency did not announce how it would test for xenon or argon doping, which may be hard to detect beyond measuring variable HIF-1α or EPO levels.

El B_{40} un futbolè de bor

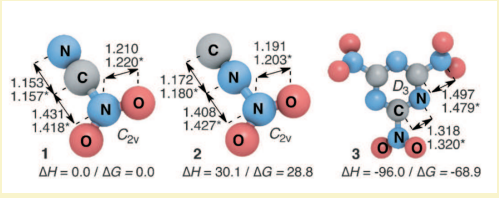
The discovery of soccer-ball-shaped buckminsterfullerene in 1985 inspired researchers to lock atoms of a single element together into novel shapes; but the search for one alluring nanostructure has vexed researchers for decades. A team is now reporting the first molecular cage made entirely of boron (Hua-Jin Zhai et al.,*Nat. Chem*. **2014,** *6,* 727; DOI: 10.1038/nchem.1999). The researchers have now identified and characterized borospherene by combining computational chemistry and spectroscopic techniques. Using supercomputers, the team screened more than 10,000 structures made of 40 boron atoms. Two energetically favorable types of candidates emerged: all-boron fullerenes and quasiplanar sheets. The scientists then calculated electron binding energies for both types of structures to produce simulated photoelectron spectra. The team blasted a boron target with a laser to produce a vapor of atoms that condensed into boron clusters as it was cooled by helium gas. The team found that only a mixture of the spectra from simulated planar and fullerene structures could produce the experimental spectrum. Unlike a C_{60} buckyball's regular patchwork of pentagons and hexagons, the newly discovered boron molecule, B_{40}, looks a bit like a rounded box with two hexagonal lids, four heptagonal sides, and 48 triangles filling out its form. The boron-boron bonds in the "borospherene" are also exotic. Delocalized π- and σ-bonds hold the boron fullerene together, with electrons shared among three, five, six, or seven atoms.



The carbon buckyball has a boron cousin. A cluster for 40 boron atoms forms a hollow cage-like molecule.

Cianur de metil, molta energia en poc espai

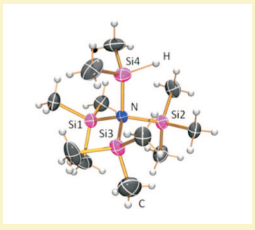
Nitryl cyanide, $N{\equiv}CNO_2$, looks energetic and relatively simple on paper. Computational models have long suggested it's a potentially useful high-energy-density compound. It could also play a role in atmospheric and interstellar chemistry. But the molecule is so reactive that nobody has managed to prepare, isolate, and characterize it—until now. After much investigation, M. Rahm et al. (*Angew. Chem. Int. Ed.* **2014**, *53*, 6893; DOI: 10.1002/anie.201404209) have found that the reaction of NO_2BF_4 with $R'R_2SiC{\equiv}N$ (R′ = tert-butyl, R = methyl) in nitromethane —performed under carefully controlled temperature and concentration—allowed them to produce $N{\equiv}CNO_2$ in 50% yield. The vibrational spectra of $N{\equiv}CNO_2$, which is a stable gas at room temperature, agreed with predicted spectra. The compound's potential, not only as a rocket propellant but also as a building block for other energetic materials, should prompt much new investigation, the researchers say. They also note that $N{\equiv}CNO_2$ resembles other nitriles observed in interstellar space and could be a target for astronomers to pursue.



Cinaur de nitril (1), isocianur de nitril (2) i 2,4,6-trinitro-1,3,5-triazina (3)

L'amoni persililat

A research team has prepared a long-awaited silicon analog of a tetraalkyl ammonium cation. The persilylated ammonium salt has been heralded as a "trophy molecule" (A. Schulz et al., *Organometallics* **2014**, *33*, 3223; DOI: 10.1021/om500519j). The achievement comes after more than 20 years of research by multiple groups on silylium cations, SiR_3^+ (where R is an alkyl or aryl group), which have been pursued by chemists interested in comparing the properties of silicon and carbon compounds. Along the way an array of silylium-containing species has been reported, including $S[Si(CH_3)_3]_3^+$ and $P[Si(CH_3)_3]_4^+$, but never a persilylated ammonium cation such as $N[Si(CH_3)_3]_4^+$. One approach adopted by Schulz and his team, which had been unsuccessful by others in the past, was to attempt direct silylation of $N[Si(CH_3)_3]_3$ with a silylium cation. The researchers pulled it off, but not without a hitch: Using the bridging hydride compound $[(CH_3)_3SiHSi(CH_3)_3][B(C_6F_5)_4]$ as a silylating reagent resulted in the loss of a methyl group, leaving the molecule one methyl shy of a full house. The researchers determined that the unexpected loss of the methyl group results from a methyl-hydrogen exchange reaction catalyzed by the silylating agent.



Breus

• Ha estat confirmada la síntesi de l'element Ununsepti, Uus, a partir de ^{48}Ca i ^{249}Bk (J. Khuyagbaatar et al., *Phys. Rev. Lett*. **2014**, *112*, 172501; DOI: 10.1103/physrevlett.112.172501). Un cop la IUPAC i la IUPAP, ho ratifiquin, només faltarà un element per completar la setena fila de la taula periòdica.

• Un estudi de la relació isotòpica $^{17}O/^{16}O$, (D. Herwatz et al., *Science*, **2104**, *344*, 1146; DOI:10.116/science.1251117), sembla demostrar que la Lluna es formà per un impacte entre *Theia*, un cos de la mida de Mart, i la Terra.

• Una revisió del famós estudi de L. Miller de l'any 1953 -feta per un antic alumne seu- sobre la formació d'aminoàcids en sotmetre una mescla de metà, amoníac, hidrogen i aigua, a descàrregues elèctriques, prova que es formen, també, un bon nombre de dipèptids i tripèptids (J.L. Bada, et al., *Angew. Chem. Int. Ed.* **2014**, *53*, 8132; DOI:10.112/anie.201403683).

L'element

L'element número 68, **erbi,** fou descobert per Carl G. Mosander a Suècia, l'any 1843; el nom prové del de Ytterby, un poble de l'arxipèlag d'Estocolm. El 1905, Georges Urban i Charles James, independentment, van obtenir l'òxid (Er_2O_3); el metall pur, no es va preparar fins l'any 1934, per reducció del clorur ($ErCl_3$) amb vapor de potassi. És un dels lantànids més abundants, a l'escorça terrestre n'hi ha 2,8 mg/kg, que el fan l'element 45è més abundant, de fet ho és el doble que l'estany. Les principals minerals que el contenen es troben a la Xina i els EUA, i la producció anual és d'unes 500 Tm. Té sis isòtops estables, dels quals el més abundant és ^{166}Er, amb un 33%; es coneixen, a més, vint-i-nou isòtops radioactius, sent ^{169}Er el de vida mitjana més llarga (9,4 dies). Les principals aplicacions són les de l'òxid, pricipalment en la indústria nuclear com a captador de neutrons i en el món de les comunicacions com a component de diversos tipus de fibra òptica. L'aliatge, Er_3Ni, té una capacitat calorífica molt elevada, a la temperatura de l'He líquid, que el fa útil en criòstats que treballen a baixes temperatures. Com a curiositat, a destacar que és el millor, sinó l'únic, pigment de color rosa, de vidres, cristalls, joies i ceràmica.

Avui recomanem

La pàgina web que *Chemical&Engineering News* (http://cen.xraycrystals.org) ha fet en motiu de l'Any Internacional de la Cristal·lografia (Vg. *Not. Inorg*., *66,* Febrer, **2014**). Entre altres opcions, posa a disposició de l'usuari un milió d'estructures.