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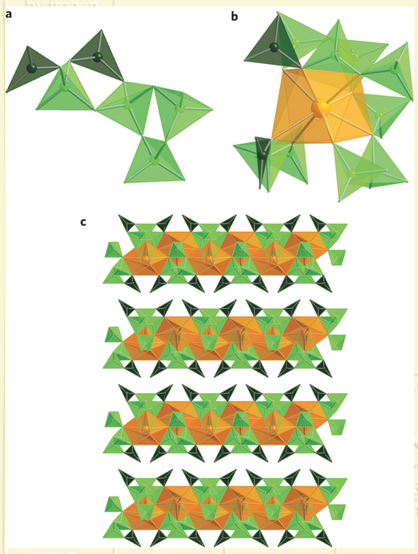
El californi sorprèn

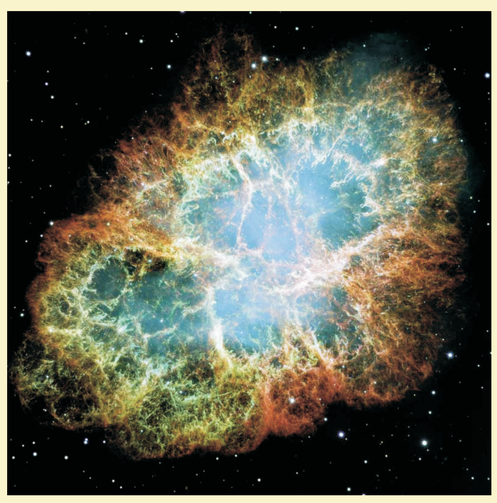
The bonding of the heaviest element that exists in usable quantities on Earth has just got a lot more interesting. Californium is the last member of the actinide series with an isotope long-lived enough to be studied in a standard radiological facility. It was thought that its chemistry was dominated by ionic interactions, but the applecart is upset with a report that it bonds covalently to borate; this californium borate has potential implications for disposal of nuclear fuels. Wrap a Cf(III) center in polyborate chains and it looks much like a transition metal with covalent bonds to ligands, (T. E. Albrecht-Schmitt et al., *Nat. Chem*., **2014**, *6*, 387; DOI: 10.1038/nchem.1896). Spectroscopic and computational analyses indicate that the Cf–O bonds contain significant covalent character, with electron donation from oxygen 2p orbitals to californium 6d, 7p, and 5f orbitals. The ability to form covalently bonded actinide compounds could change approaches to separating and storing nuclear waste.



The layered structure of $Cf[B_6O_8(OH)_5]$ is shown with CfO_8 polyhedrons in orange, BO_4 tetrahedrons in light green, and BO_3 triangles in dark green.

L'argó reacciona a l'espai

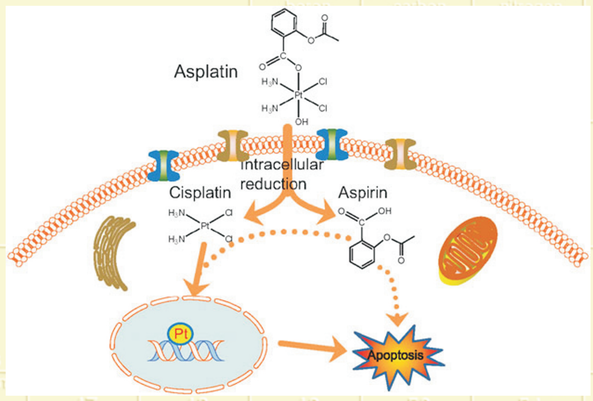
A molecule containing a noble gas has been discovered in space using an instrument aboard Europe's Herschel Space Observatory (M. Baelow, et al., *Science*, **2013**, *342*, 1343; DOI: 10.1126/science.1243582). The molecule, argon hydride, was seen in the Crab Nebula, the remains of a star that exploded 1,000 years ago. Before the discovery, molecules of this kind have only been studied in laboratories on Earth. The Crab Nebula was only formed 1000 years ago when a massive star exploded, not only is it very young in astronomical terms, but also relatively close, at just 6,500 light years away, providing an excellent way to study what happens in these stellar explosions. As molecules spin in space, they emit light of very specific wavelengths, or colours, called "emission lines". The precise wavelength is dictated by the composition and structure of the molecule. Studying the emission lines observed by the SPIRE instrument allows astronomers to study the chemistry of outer space.



Composite image of the Crab nebula (Hubble Scape Telescope)

L'aspirina potencia el *cis*-platí

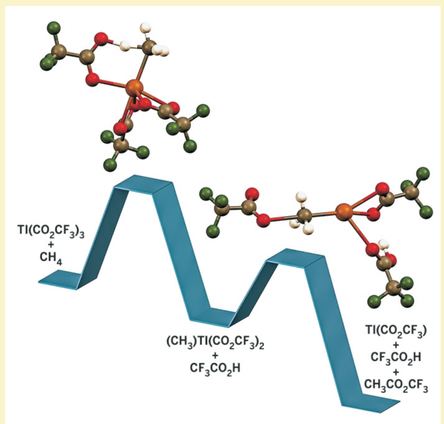
Cisplatin, along with other chemotherapeutic drugs, is used to treat various types of cancer, including testicular, ovarian, lung and bladder cancer. However, clinical use of cisplatin is limited by developing resistance, earning it the nickname the 'penicillin of cancer'. Resistance mechanisms to cisplatin are well defined, but there are still no treatments available to surmount or reverse it. New research shows, that anchoring aspirin onto cisplatin could create a cancer treatment capable of overcoming drug resistance in cisplatin resistant cells. The researchers (Q. Cheng et al., *Chem. Comm*., **2014**; DOI: 10.1039/c4cc00419a) have made and tested a cancer fighting molecule that seems to evade cisplatin's resistance problems. **Asplatin** is a fusion of cisplatin and aspirin and is generated from a nucleophilic substitution reaction between oxoplatin and acetylsalicylic anhydride. The reaction is simple and the raw materials are relatively cheap. Asplatin has been tested on human breast, lung and cervical cancer cells, cisplatin resistant cancer cells as well as mouse models, and it exhibits significant cytotoxicity to cancer cells and is up to 10 times more effective than cisplatin. In addition, asplatin almost fully overcomes the drug resistance of cisplatin resistant cells.



Upon cellular uptake, **asplatin** is reduced by ascorbic acid to give cisplatin and aspirin.

Una altra cara del gas natural

The U.S. natural gas production boom is presenting a wealth of new research opportunities for chemists. The scientists have been getting creative in designing new methods for converting plentiful natural gas into fuels and chemicals that can better compete economically as alternatives to petroleum-derived products. Now (B. G. Hashiguchi et al., *Science*, **2014**, *343*, 1232; DOI: 10.1126/science.1249357) has discovered that inexpensive main-group thallium and lead complexes work well at converting the typically unreactive alkanes in natural gas into alcohol esters . The new chemistry operates more selectively and at much lower temperatures than conventional natural gas reforming methods that operate at about 900 °C. The soluble thallium(III) or lead(IV) salts in trifluoroacetic acid solvent operate stoichiometrically at only 180 °C, which in an optimized commercial catalytic process could lead to substantial energy savings. Using computational and experimental studies, the team found that thallium and lead trifluoroacetate complexes activate C–H bonds without radical formation to generate metal alkyl intermediates, which selectively leads to the alcohol trifluoroacetate esters.



This energy diagram shows how a thallium trifluoroacetate complex coordinates methane and then rips apart a C–H bond on the way to forming a methanol trifluoroacetate ester

Breus

• Quasi un miler de científics han signat un document de protesta contra la discriminació de gènere mantinguda en els oradors participants en la majoria de congressos de química; en concret es demana el boicot al **15th International Congress of Quantum Chemistry** que tindrà lloc el proper juny a Beijing.

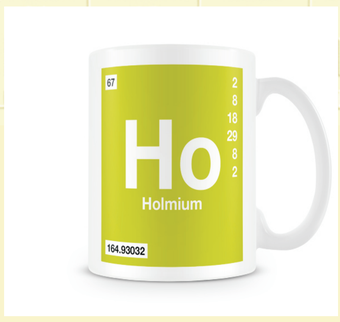
• El prestigiós **Max-Planck-Institut für Kohlengforshung** dedicat a la recerca bàsica de tots els aspectes de la catàlisi, celebra el seu centenari. Entre els seus descobriments més importants s'han de citar el procés Fischer-Tropsch, la polimerització de l'etè (Ziegler) i la ciclo-oligomerització de l'1,3-butadiè (Wilke).

•S'ha dissenayt una impressora 3D que permet la impressió d'estructures cristal·lines en tres dimensions, a partir del fitxer CIF (*CrystaEngComm*., **2014**; DOI:10.1039/c4ce00371c).

Avui recomanem

La nova sèrie de vídeos de l'ACS, «**Breakthrough Science**», sobre els articles més destacats apareguts en les més de 40 revistes de la Societat (pubs.acs.org/page/videos/breakthroughscience.html).

L'element



L'element número 65, l'**holmi**, fou descobert per Marc Delafontaine i J. L. Soret a Ginebra, l'any 1878, en detectar unes noves bandes espectrals en l'estudi de substàncies derivades de la gadonilita, que és un dels minerals que conté tots els lantànids. El mateix any i de manera independent, Per Theodor Cleve el descobrí a Uppsala, com a una impuresa de l'òxid d'erbi. El nom prové del mot llatí *holmia* que vol dir Estocolm.

Com els altres lantànids, l'holmi es troba als minerals gadolinita i monazita abundants a la Xina, EUA, Brasil, India i Austàlia; les reserves estimades d'holmi són unes 400.000 Tm. La producció anual és d'unes 10 Tm anuals; en ser l'element amb el moment magnètic més alt, 10,6 μB, s'empra en la fabricació dels imants més potents; s'usa també en la indústria nuclear en el control del reactors. Els làsers que contenen Ho operen a una longitud d'ona de 2,08 micròmetres, que no és detectada per l'ull humà, i els fa molt útils en cirurgia.

Conté un únic isòtop estable, Ho-165, i alguns de radioactius. No s'ha trobat que tingui cap activitat biològica, encara que les seves sals estimulen el metabolisme.