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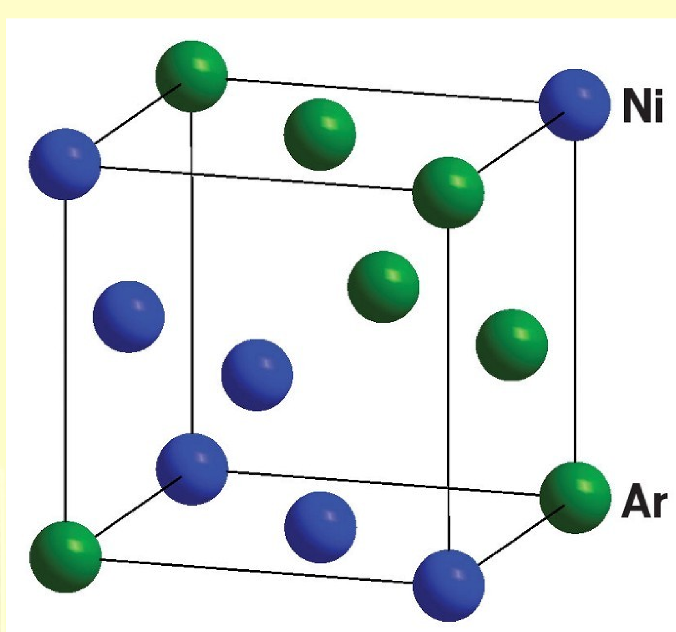
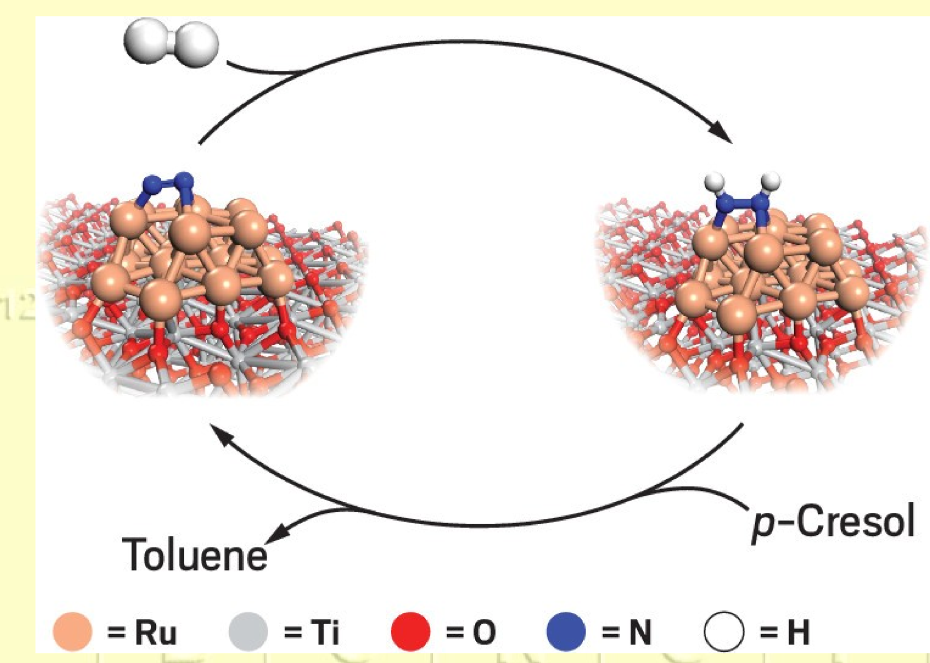
Aliatges d'argó

Extraordinary pressures and temperatures lead to extraordinary chemistry. Usually, noble gases are among the least reactive elements. Yet tremendously high heat and pressure can bring out chemical traits never seen before. In a simulated environment mimicking the pressure cooker environment of Earth's core, researchers observe the first stable compound between argon and a metal: ArNi (E. Stavrou et al., *ACS Earth Space Chem.*, **2019**, DOI: 10.1021/acsearthspacechem.9b00212). The group put a small amount of powdered nickel in between two micrometer-scale diamonds in a diamond anvil cell, added argon gas, and squeezed the diamonds together. Once the pressure reached 140 GPa, 1,300 times the pressure at the ocean's lowest depth, the researchers turned on an infrared laser to heat the mixture. Close to 1,500 K, the temperature of a hot charcoal fire, the X-ray diffraction pattern changed, indicating that argon and nickel had formed something new. Experiments pointed to an alloy of 50% argon and 50% nickel. Theoretical calculations matched a crystal structure of an intermetallic alloy, showing argon and nickel equally interspersed in a solid that is metallic in nature.



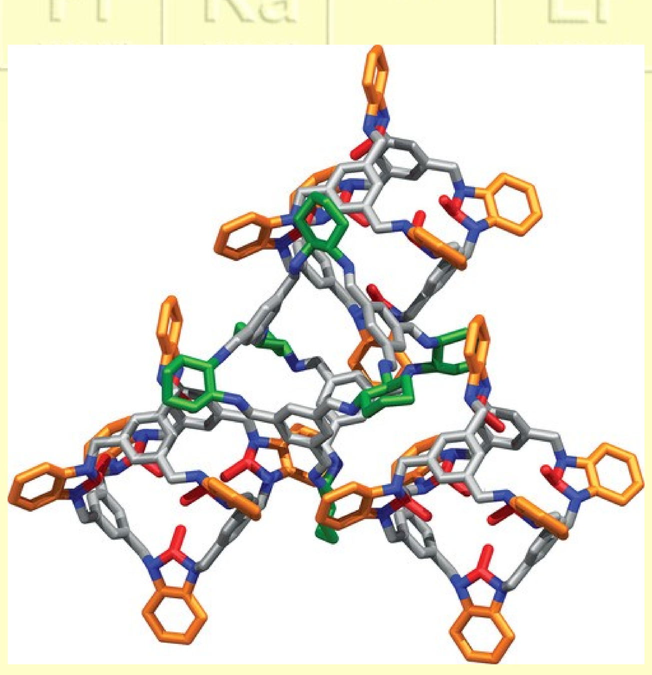
El N_2: inert i catalitzador alhora

Gaseous nitrogen is a bit of a chemical wallflower. While high temperatures and pressures such as those used in the Haber-Bosch process can convince the compound to react, gaseous N_2 rarely acts as an active catalytic species. Now a group of international researchers has found that adding N_2 gas to a ruthenium-based catalyst speeds up the hydrodeoxygenation of p-cresol into toluene by over 400%; it's a reaction that could have applications in converting bio-oils into useful chemicals (J. Li et al., *Nat. Catal.*, **2019**, DOI: 10.1038/s41929-019-0368-6). The researchers stumbled across this chemistry when trying to pressurize their reactor with an inert gas. They added gaseous N_2 to a solid-state titanium oxide–supported Ru catalyst, with hydrogen gas and p-cresol, and found that the Ru surface activates the N_2 to form either N_2H or N_2H_2. These acidic hydrogens help boot the –OH groups off the p-cresol, shifting the rate determining step from –OH hydrogenation to N_2 hydrogenation. The group found that the reaction worked well over multiple supports, including Al_2O_3, ZrO_2, and active carbon.



H_2 i D_2 separats quànticament

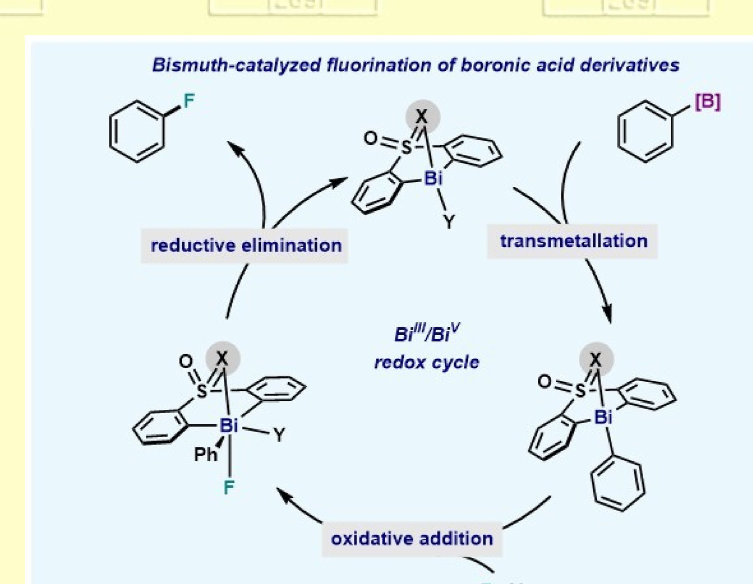
High-purity deuterium is an essential ingredient for next-generation nuclear fusion and other scientific applications, but getting D_2 isn't easy. It's made either by electrolysis of heavy water followed by extraction or via distillation at a chilly –249 °C. Looking to sidestep these expensive and energy-intensive processes, scientists have sought to separate H_2 and D_2 with porous materials by a process known as kinetic quantum sieving. With this method, pores of a certain size preferentially confine the heavier isotope D_2 over lighter H_2 because of differences in their zero point energy—a quantum mechanical property. The problem is that the pores need to be very small, on the order of 2 Å wide, but materials with pores that small fill up quickly, so they don't take up much D_2. A team used organic synthesis to address this problem (A. I. Cooper, *Science*, **2019**, DOI: 10.1126/science.aax7427). By adjusting the apertures in structurally similar cage molecules, they were able to create cages with small pores for sieving D_2 and cages with large pores for storing D_2. They cocrystallized these materials, which resulted in a material that has excellent selectivity for D_2 and high D_2 uptake.



These cocrystallized cage molecules feature cages with small openings for sieving deuterium (structures with orange and red groups) and large openings for storing deuterium (structure with green groups).
Blue = N; all other colors = C

El Bi "quasi" un metall de transició

Think of bismuth as the Cinderella of the periodic table. Because it is surrounded by its toxic stepsiblings—the elements lead, tin, antimony, tellurium, and polonium—chemists often overlook bismuth as a possible reagent. But bismuth and its compounds are safe enough to use in pharmaceuticals, in cosmetics, and as a replacement for lead materials in plumbing systems. Now, chemists at the Max Planck Institute for Kohlenforschung are giving bismuth a chance to shine, plucking it from the periodic table and fashioning it into a redox complex that mimics the actions of a transition-metal catalytic cycle. But bismuth has some peculiar properties. It can coordinate up to nine ligands and adopt geometries that differ from those of transition metals. Still, Cornella's team was able to design and build a bismuth catalyst that fluorinates aryl boronic acids and esters through a Bi(III)/Bi(V) redox cycle (J. Cornellà et al., *Science* **2020**, DOI: 10.1126/science.aaz2258). Although it is not expected that this fluorination to replace existing methods for this reaction, this work should be considered one of the most important advances in molecular bismuth chemistry and a landmark in the field of main-group chemistry.



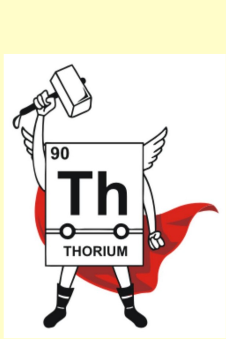
Breus

- Segons el "*Nature Index 2019 Annual Tables highlights*" Espanya es el desè país per la qualitat de la seva recerca en química. (https://www.natureindex.com/news-blog/these-ten-countries-top-the-ranks-in-chemistry-research)
- Nanopartícules de sílice poden travessar la paret estomacal i transportar insulina directament a la sang, obrint la porta a un tractament oral de la diabetis. (*Nat. Biomed. Eng.*, **2019**, DOI:10.1038/s41551-019-0465-5)
- S'ha provat que l'impacte d'un asteroide a la terra fa 60 milions anys, que provocà l'extinció massiva de moltes espècies, fou també responsable de l'acidificació dels oceans que a la vegada causà la desaparició de moltes famílies d'animals marins. (*Proc. Natl. Acad. Sci. U.S.A.*, **2019**, DOI:10.1073/pnas.1905989116).

Avui recomanem

- El vídeo "*Sea of Instability*" de la sèrie "*Speaking of Chemistry*" que explica la síntesi dels elements superpesants. (http://cen.speakingofchemistry.org/)

L'element



L'element número 90, **tori**, fou descobert l'any 1829 pel mineralogista noruec Morten Thrane Esmark, i identificat per Berzelius, que el nomenà en honor de "Thor", el déu escandinau de la guerra. Tots els seus 30 isòtops són inestables, el ^{232}Th és el més estable amb una vida mitjana de 14 mil milions d'anys, quasi tant com l'edat de l'univers. Conjuntament amb el bismut, el protoactini i l'urani, són els quatre elements radioactius que es troben a la terra amb quantitats significatives. El principal mineral és la monazita, fosfat de diverses terres rares, que es troba, principalment, a l'Índia, Sudàfrica i Brasil. La seva principal aplicació és com a font d'energia nuclear. El ThO_2, anomenada tòria, que és un dels compostos amb un punt de fusió més alt, 3.300 ºC, s'empra com a catalitzador i en la indústria electrònica.

El tori ha sofert diverses ubicacions a la Taula periòdica al llarg del temps. Inicialment, Mendeléiev el col·locà en el grup dels alcalinoterris, posteriorment -en confirmar-se la valència 4- s'ubicà en el grup del Ti. El 1892 en introduir-se un període llarg a la Taula passà a formar-ne part. Finalment, quan a partir de 1945, Glenn T. Seaborg començà a preparar els elements transurànids, trobà el seu lloc definitiu com a membre dels actínids.