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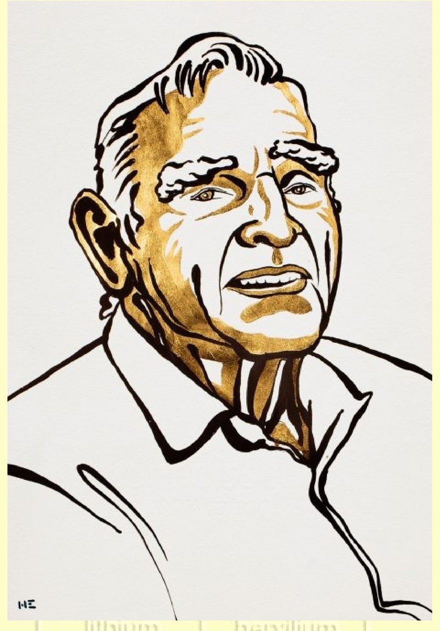
Nobel inorgànic

The 2019 Nobel Prize in Chemistry has been awarded to John B. Goodenough of the University of Texas at Austin, M. Stanley Whittingham of Binghamton University, and Akira Yoshino of Asahi Kasei and Meijo University "for the development of lithium-ion batteries." The three will share the roughly $1 million prize equally.

The story of lithium-ion batteries' discovery dates back to the 1970s, during the decade's oil crisis. Whittingham was researching energy-rich materials when he figured out how to make a battery cathode from TiS_2, a layered material, and lithium ions slip between its layers. But the battery had flaws. The lithium metal could form wispy needles that caused the battery to short-circuit, overheat, and then, possibly, explode. Goodenough discovered that lithium ions could also intercalate through cobalt oxide. Around the same time, Yoshino showed that lithium ions could also intercalate in petroleum coke. (https://www.nobelprize.org/prizes/chemistry/)

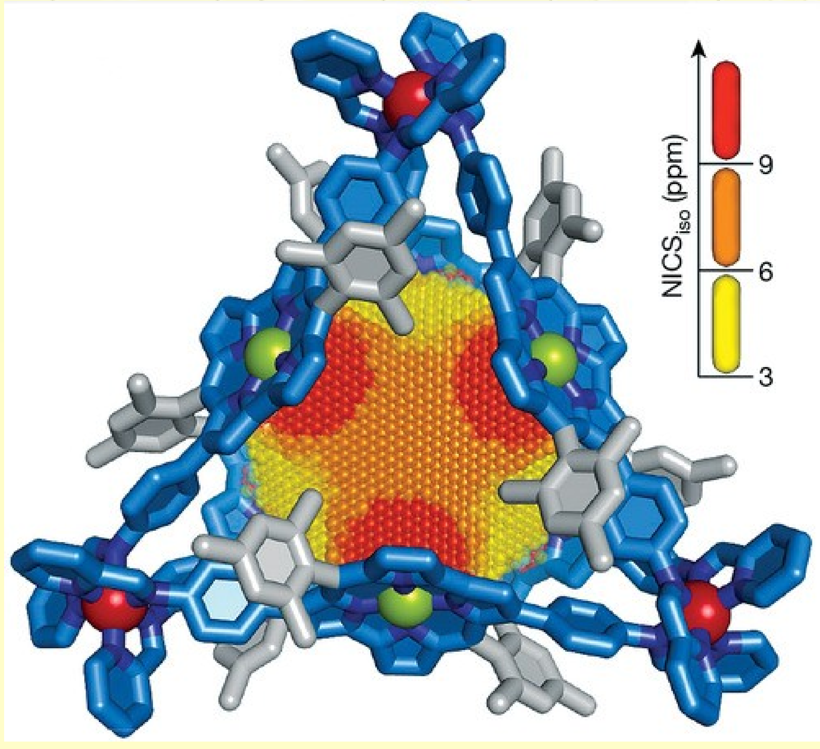

J. B. Goodenough


S. Whittingham


A. Yoshino

Una *nanogàbia* antiaromàtica

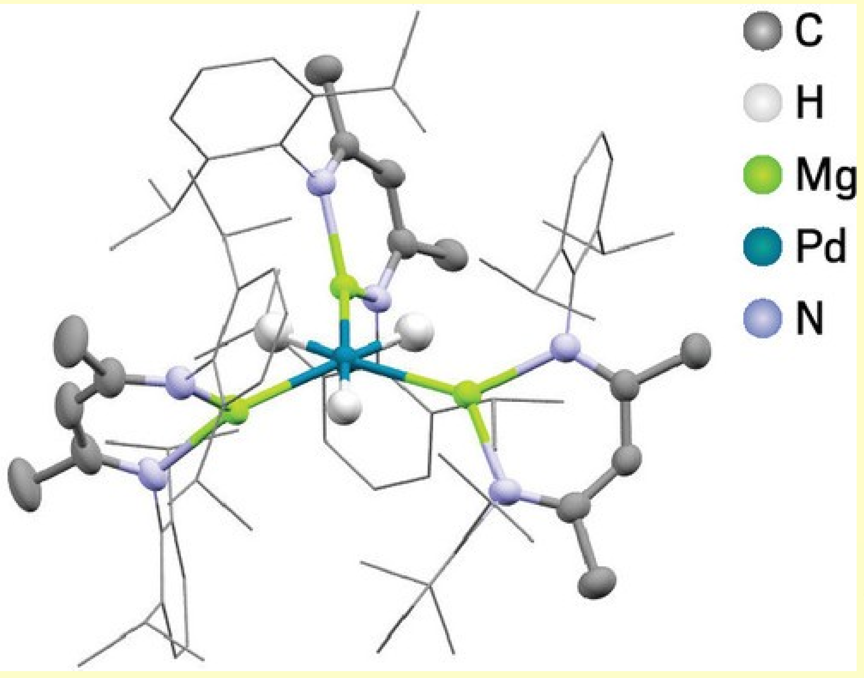
A nanosized cage with antiaromatic walls that boasts some peculiar magnetic properties has been reported (J. Nitschke et al., *Nature* **2019**, DOI: 10.1038/s41586-019-1661-x). According to the Hückel's rule, a molecule is aromatic if it has $4n + 2$ π electrons in a system of rings containing conjugated double bonds. That aromaticity increases the stability of the compound. But when a cyclic conjugated compound has $4n$ π electrons, it is antiaromatic. These molecules are typically unstable and reactive, and the rings have a paramagnetic ring current that can be seen with nuclear magnetic resonance spectroscopy. To build the nanocage, the team used some relatively stable antiaromatic nickel(II) norcorrole building blocks and then added substituents and iron ions until the conditions were right for the molecule to self-assemble into a tetrahedral shape that could hold guest molecules inside.



Blue sticks represent antiaromatic walls; gray represents substituents on walls. Ni = green; Fe = red.

Un Pd hexagonal

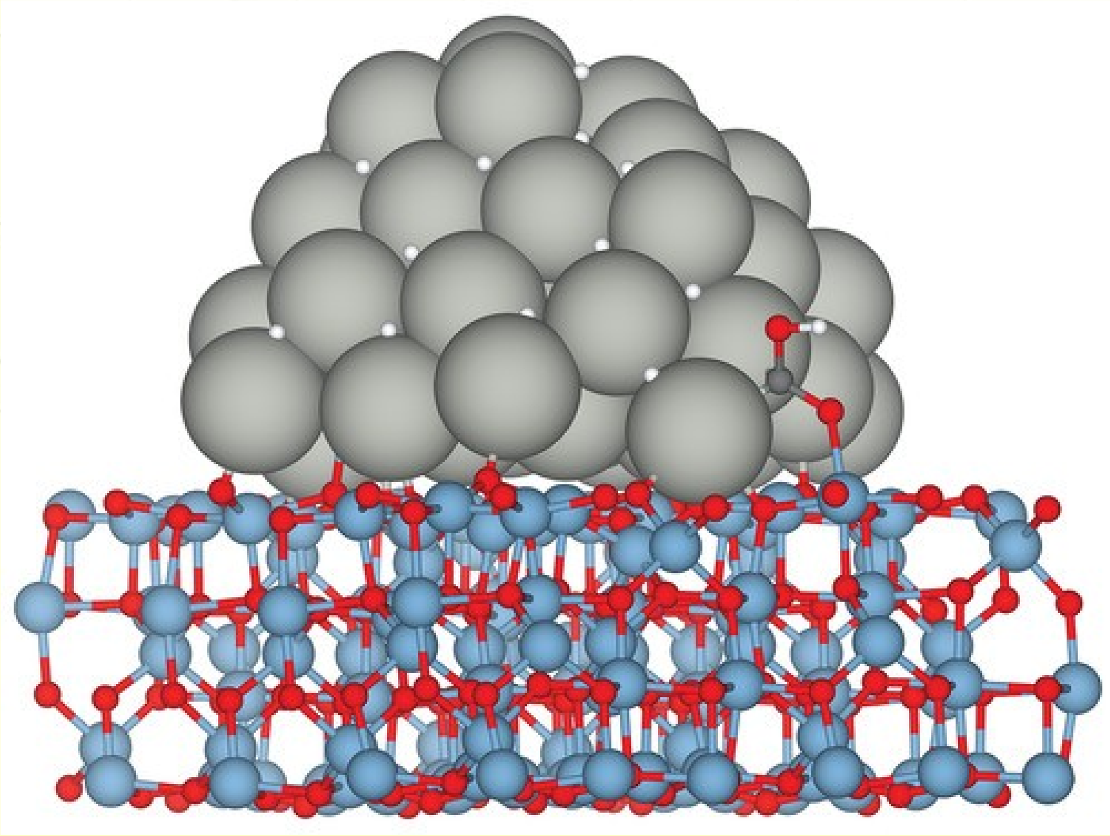
The geometries of transition-metal complexes generally take on only a few structures, such as octahedral, trigonal bipyramidal, and square planar shapes. Scientists proposed a hexagonal planar geometry more than 100 years ago, but it has never been captured in crystal form until now (Mark R. Crimmin et al., *Nature* **2019**, DOI:10.1038/s41586-019-1616-2). The team nabbed the structure with a complex consisting of a palladium atom surrounded by three hydride and three magnesium-diisopropylphenyl ligands. The magnesium ligands accept electron density from the palladium, and, with this geometry, the hydrides overlap well with filled palladium d orbitals to stabilize the compound.



La reacció de gas d'aigua al descobert

Industry has depended on the water-gas shift (WGS) reaction for more than a century. The WGS process, which combines carbon monoxide and water to form carbon dioxide and hydrogen, is a key component of industrial plants that use hydrogen to process hydrocarbons or to synthesize ammonia or methanol.

Now the nature of the catalytically active site and reaction pathway, key pieces of information needed for improving catalyst performance, have been found (V. Glezakou et al., *Nat. Catal.* **2019**, DOI: 10.1038/s41929-019-0343-2). They found that the key intermediate is a carboxylate species that bridges palladium and aluminum atoms and that a formate intermediate, proposed by other researchers, is a minor player in this chemistry. The team determined that the catalytically active sites, which form only under reaction conditions, are hydroxides coupled to negatively charged palladium atoms at the Pd-Al_2O_3 interface.


This carboxylate intermediate plays a key role in water-gas shift chemistry. Pd = light gray; C = dark gray; Al = blue; O = red; H = white.

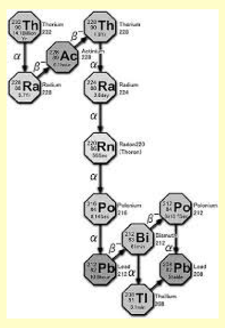
Breus

- S'ha començat a desenvolupar programari per ensinistrar l'ALEXA en la terminologia química i capacitat de comandar operacions de laboratori senzilles. (*C&EN,* **2019**, 97(36), 16 de setembre)
- Un estudi fet a partir de les opinions de 373 investigadors de 41 països, conclou que calen 14 hores per formatejar adequadament cada article que es publica, feina que equival a una despesa de 477$ que assumeix l'autor.(A.G. LeBlanc, et al., *PLoS One*, **2019**, doi.org/10.1371/journal.pone.0223116).
- S'ha fabricat un ordinador amb més de 14.000 transistors de nanotubs de carboni, capaç de fer funcionar programari senzill. Aquest fet pot ser un primer pas per a la introducció dels nanotubs de carboni en la indústria electrònica. *(C&EN*, **2019**, 97(35), 9 de setembre)

Avui recomanem

- El llibre d'Agustí Nieto-Galan, catedràtic d'Història de la Ciència a la UAB, "*The Politics of Chemistry. Science and Power in Twentieth-Century Spain*", Cambridge University Press, 2019. L'obra descriu la influència, poc coneguda, de la química i d'alguns químics en la història d'Espanya d'aquest període.
- L'exposició d'enguany del Fons Històric de la Biblioteca de Física i Química, "**Cent anys del descobriment del protó. Rutheford pare de la física nuclear**". Es commemora el centenari de la primera reacció nuclear creada artificialment, bombardejant nitrogen amb partícules α, que permeté descobrir els protons com a components dels nuclis atòmics.

L'element



L'element número 89, **actini**, fou descobert pel químic francès Andre Debierne el 1899, analitzant residus de pechblenda; posteriorment, el 1902, Friedrich O. Giesel, treballant en la separació de les anomenades terres rares, trobà un substancia semblant al titani i li posà "emanium", sense adonar-se que es tractava de l'actini. El nom prové del grec "aktinos" que vol dir raig o radiació. Es troba com a traces en minerals d'urani –una Tm de pechblenda conté 150 mg– i també de tori. Es coneixen dos isòtops naturals, ^{227}Ac i ^{228}Ac, formats en les sèries de descomposició radioactiva de l'urani i el tori, respectivament. En conjunt s'han identificat 36 isòtops, dels quals ^{227}Ac és el més estable amb una vida mitjana de 21.77 anys.
Dóna nom al grup dels actínids, un conjunt de 15 elements de propietats anàlogues entre el mateix actini i el lawrenci. El metall s'obté per reducció del fluorur, AcF_3, amb liti a uns 1200º C de temperatura. El ^{225}Ac s'usa en medicina nuclear en el tractament de tumors amb partícules α.