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 TiS₂, 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/)

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.

The 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.

Avui recomanem
- L’exposició d’enguany del Fons Històric de la Biblioteca de Física i Química, “Cent anys del descobriment del protò. Rutheford pare de la física nuclear”. Es commença el centenari de la primera reacció nuclear creada artificialment, bombardejant nitrogen amb partícules α, que permetí descobrir els protons com a components dels nuclis atòmics.

L’element
L’element número 89, actini, fou descobert pel químic francès Andre Debierre el 1899, analitzant residus de pechblenda; posteriorment, el 1902, Friedrich O. Giesel, treballant en la separació de les anomenades terres rares, trobà un substància semblant al titani i li posà “emanium”, sense adonar-se que es tractava de l’actini. El 227Ac s’usa en medicina nuclear en el tractament de tumors amb partícules de β-radiació. (C&EN, 2019, 97(35), 9 de setembre)