“Molecular balls” for a new type of catalysis

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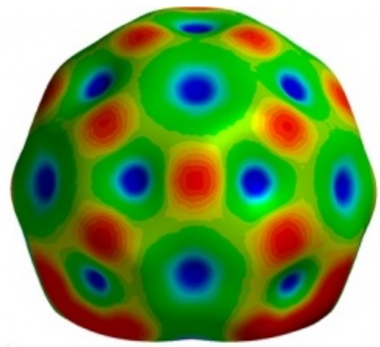
NCCR Molecular Systems Engineering researchers at University of Geneva show how electrons can move together on the surface of molecular balls formed of carbon atoms and allow a new type of catalysis.



Researchers at the University of Geneva (UNIGE) have discovered that C60 fullerene (molecular balls) are excellent catalysts. Their structure is made of 60 carbon atoms arranged in a sphere, thus making them look like a football but 10 million times smaller! They are also called fullerenes, because of their resemblance to the geodesic domes of the American architect Buckminster Fuller. The discovery of fullerenes was rewarded by the Nobel Prize in Chemistry in 1996. A research to discover in the journal Angewandte Chemie.

The composition of these molecular balls, made only of carbon, seemed to make them unsuitable for catalysis, but the group of Stefan Matile, of the Department of Organic Chemistry of the Faculty of Sciences of UNIGE, in collaboration with theoreticians of Palma de Majorca, has proven the opposite. Their surface can indeed be activated by a new type of interactions, "anion-π interactions", discovered by the Matile group in 2013 and which take advantage of the 60 electrons, one per carbon atom, that are delocalized on the surface of the C60 fullerenes. The distribution of these free electrons can change when a substrate - a molecule to be transformed - comes into contact with them, thus initiating anion-π interaction and thus the transformation of the substrate. This is a very particular catalysis, in which the catalyst emerges only in contact with the substrate. In other words, it is the substrate that creates its own catalyst.

But unlike football, it is when two balls are used at the same time that the game takes all its interest: the Geneva group shows that the 60 free electrons of each of them can move together, thus offering 120 electrons available to shape the catalyst at the arrival of the substrate.

Reference

J. López-Andarias, A. Bauzá, N. Sakai, A. Frontera, S. Matile, Remote Control of Anion–π Catalysis on Fullerene-Centered Catalytic Triads, Angew. Chem. Int. Ed., 2018, 57(34), 10883-10887, doi: 10.1002/anie.201804092

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About the NCCR Molecular Systems Engineering

Molecular Systems Engineering is a National Centre of Competence in Research (NCCR) funded by the Swiss National Science Foundation (SNSF), and headed by the University of Basel and ETH Zürich. Molecular systems engineering attempts to capture the complexity and emergent properties prevalent in biology. The uniqueness of this initiative relies on the combination of both chemical- and biological modules. In this approach, complex dynamic phenomena emerge as the result of the integration of molecular modules (molecular- or biological prosthetics) designed to interact in a programmed way with their complex environment. In this manner, it should be possible to create molecular factories and cellular systems whose properties are more than sum of the attributes of the individual modules. These new system-level properties emerge through the interactions of chemical- and biological networks assembled from the individual modules.

Links

NCCR Molecular Systems Engineering

Matile Group