

A new synthesis method for threedimensional nanocarbons

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A new synthesis method creates curved octagonal structures by linking benzene rings. Credit: Issey Takahashi

A team of scientists led by Kenichiro Itami, Professor and Director of the Institute of Transformative Bio-Molecules (WPI-ITbM), has developed a new method for the synthesis of three-dimensional nanocarbons with the potential to advance materials science.



Three-dimensional nanocarbons, next-generation materials with superior physical characteristics which are expected to find uses in fuel cells and organic electronics, have thus far been extremely challenging to synthesize in a precise and practical fashion. This new method uses a palladium catalyst to connect polycyclic aromatic hydrocarbons to form an octagonal structure, enabling successful three-dimensional nanocarbon molecule synthesis.

Nanocarbons, such as fullerene (a sphere, for which the 1996 Nobel Prize was awarded), the <u>carbon nanotube</u> (a cylinder, discovered in 1991) and graphene (a sheet, for which the 2010 Nobel Prize was given) have attracted a great deal of attention as functional molecules with a variety of different properties. Since Mackay et al. put forward their theory in 1991, a variety of periodic three-dimensional nanocarbons have been proposed.

However, these have been extraordinarily difficult to synthesize. A particular challenge is the eight-membered ring structure, which appears periodically, necessitating an efficient method for its synthesis. To do so, Dr. Itami's research team developed a new method for connecting polycyclic aromatic hydrocarbons using a palladium catalyst to produce eight-membered rings via cross-coupling, the first reaction of its type in the world.

The success of this research represents a revolutionary achievement in three-dimensional nanocarbon molecule synthesis. It is expected to lead to the discovery and elucidation of further novel properties and the development of next-generation functional materials.

More information: Satoshi Matsubara et al, Creation of negatively curved polyaromatics enabled by annulative coupling that forms an eight-membered ring, *Nature Catalysis* (2020). DOI: 10.1038/s41929-020-0487-0



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