Dimensional Organic Networks for Energy Conversion and Storage

Jong-Beom Baek

UNIST, 50 UNIST, Ulsan, South Korea

jbbaek@unist.ac.kr

Abstract

Since the discovery of graphene in 2004,[1] conjugated two-dimensional (2D) organic networks have attracted immense interest due to their unusual electronic, optoelectronic, magnetic and electrocatalytic properties. In addition, their tuneable structures and properties promise to offer more opportunities than graphene in various applications. However, even after years of intensive exploration of 2D materials in science and technology, facile and scalable methods capable of producing stable 2D networks with uniformly decorated heteroatoms with/without holes remain limited. To overcome these issues, new layered 2D organic networks have been designed and synthesized. They have uniformly distributed heteroatoms,[2] holes with heteroatoms[3] and transition metal nanoparticles in the holes (Figure 1).[4] The structures were confirmed by scanning tunnelling microscopy (STM). Based on the stoichiometry of the basal plane, they were, respectively, designated C_3N, C_2N and M@C_2N (M = Co, Ni, Pd, Pt, Ru). Their electronic and electrical properties were evaluated by electrooptical and electrochemical measurements along with density-functional theory (DFT) calculations. Furthermore, robust three-dimensional (3D) cage-like organic networks have also been constructed and they show high sorption properties (Figure 2).[5,6] The results suggest that these newly-developed 2D and 3D organic networks offer greater opportunities, from wet-chemistry to device applications.

References

[1] Novoselov, et al., Science, 306 (2004) 666.
[2] Mahmood, et al., Nature Communications, 6 (2015) 6486.
[3] Mahmood, et al., Proceedings of National Academy of Sciences, USA, 113 (2016) 7414.
[4] Mahmood, et al., Nature Nanotechnology, 12 (2017) 441.
[5] Bae, et al., Nature Communications, 8 (2017) 159-Highlighted in Nature Nanotechnology, 13 (2018) 4.
[6] Mahmood, et al., Angewandte Chemie International Edition, 57 (2018) DOI: 10.1002/ange.201800218.

Figures

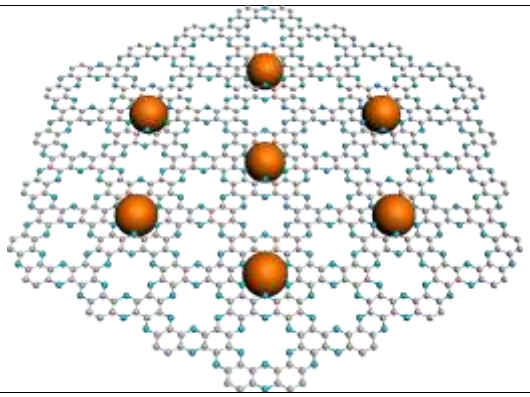

Figure 1: Schematic illustration of the structure of ruthenium on holey two-dimensional C_2N (Ru@C_2N) matrix.

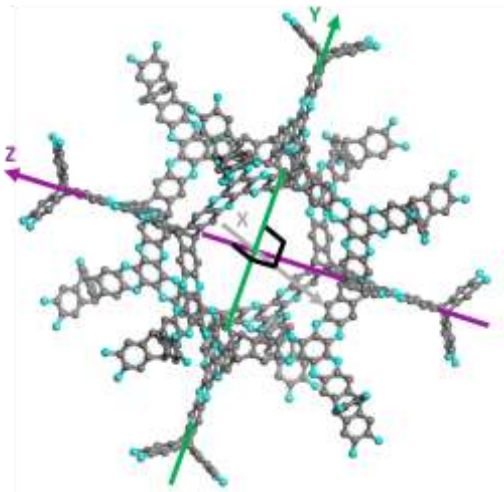

Figure 2: Insert caption to place caption below figure (Century Gothic 109