IBS Seminar

Robust Fused Aromatic Networks as a Platform for Commercial Applications

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Robust fused aromatic networks have attracted immense interest due to their unusual electronic, optoelectronic, magnetic and electrocatalytic properties. Their tunable dimensions and properties promise to offer many opportunities in various applications. Nevertheless, methods developed for the synthesis of organic conductive materials, which are capable of producing fused-aromatic based stable frameworks with uniformly decorated heteroatoms with/without holes, remain limited, even after decades of intensive exploration in science and technology. To overcome these issues, robust fused aromatic networks have been designed and synthesized. They have uniformly distributed heteroatoms,1 holes with heteroatoms,2 and transition metal nanoparticles in the holes.3 The structures were confirmed using various characterization techniques, including scanning tunneling microscopy (STM). Based on the stoichiometry of 2D layered structures, they were, respectively, designated C3N and C2N. Their electronic and electrical properties were evaluated by electrooptical and electrochemical measurements along with density-functional theory (DFT) calculations. The results suggest that these newly developed robust fused aromatic 2D network structures offer greater opportunities, from wet-chemistry to device applications. As an example, ruthenium (Ru) nanoparticles can be stably anchored on C2N structure (Ru@C2N) as an efficient electrocatalyst for water splitting.3 The Ru@C2N shows very high Faradaic efficiency (> 92%) with stability for water splitting, and thus it is useful for real applications. Devices have been fabricated for emission control, tap water electrolysis, sea water electrolysis, electrode boilers, and many others. This work suggests how a humble scientific discovery can contribute to humanity.

[1] Mahmood, et al. **PNAS** 2016, 113, 7414.

[2] Mahmood, et al. **Nat. Commun.** 2015, 6, 6486.

[3] Mahmood, et al. **Nat. Nanotech.** 2017, 12, 441.

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