High Performance Gas Sensors using MOFs and MOF-Derived Oxide Chemiresistors

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There have been efforts to develop high-performance gas sensors for various applications such as indoor/outdoor air monitoring, disease diagnosis, and explosive gas detection. Metal oxide semiconductor chemiresistors with high sensitivity, rapid response, and facile miniaturization are the representative sensing materials and their gas sensing characteristics have been modified by controlling the size, morphology, and composition of sensing materials as well as loading catalytic additives. However, further improvement is required for real applications of gas sensors. Metal organic frameworks (MOFs) composed of metal clusters and organic ligands with abundant pores, high surface area, and chemical tunability are considered as the promising candidates for sensing materials. Herein, three high performance gas sensors were fabricated using MOFs and MOF-derived metal oxide chemiresistors: 1) Monodisperse hollow hierarchical Co_3O_4 nanocages with excellent size tunability and high gas accessibility were fabricated using the template of zeolitic imidazolate fromeworks-67 (ZIF-67), which exhibited high sensitivity and selectivity to methylbenzene.[1]; 2) Pd/Co_3O_4 co-loaded In_2O_3 spheres were fabricated by coating the 2D ZIF-67 encapsulating Pd nanoparticles on In_2O_3 spheres and subsequent heat treatment, which showed high selectivity and response to acetone.[2]; 3) Hybrids of Cu_3(2,3,6,7,10,11-hexahydroxytriphenylene)$_2$ and Fe_2O_3 with type II heterojunction exhibited high NO_2 response and reversible sensing characteristics under visible light illumination at room temperature.[3] Above results show that MOFs can be used not only as excellent templates for sensing/catalytic materials but also as new semiconductor-type chemiresistors that can be operated at low temperature.

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