

Metal–Organic Framework Hybrids as Functional Materials for Sensing applications

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Abstract

The peculiar structural properties (high porosity, high surface area, tuneable morphologies, structural variety) make metal organic frameworks (MOFs) candidates of choice for sensing applications development. MOFs are stable and highly ordered crystalline porous materials with well-designed structure arising from the self-assembly of multidentate organic ligands connecting with multivalent metal nodes via strong coordination interactions. Despite their noticeable structural properties, the intrinsic low electrical conductivity hampers MOFs implementation in specific technical applications. To improve this property and expand their field of applications, MOFs can be combined with organic and inorganic materials in a hybrid fashion to produce composite materials with improved properties (both structural and conductive properties). Polymers, metal oxides, metal nanoparticles, carbon nanotubes, quantum dots and graphene related materials (GRMs) are the most used materials for the preparation of MOF composites and hybrids. In this work, different approaches to produce hybrid MOF-based materials are presented: core-shell hybrid materials obtained allowing the MOF structure to growth onto the surface of metal oxide nanoparticles, GRM/MOF-based hybrids obtained allowing the MOF structure to growth in presence of different types of GRMs, AgNPs doped MOF structures obtained by both impregnation and growth approaches. The obtained materials have been fully characterized from the morphological, structural and textural points of view highlighting the instauration of synergistic effects between the hybrid components. A selection of the produced materials underwent a preliminary screening to identify the sensing applications they are suited for (gas sensing, electrochemical sensing, metal ions detection in solution). The possibility to transform the hybrid MOF-structure into the corresponding metal oxide was also explored with the aim of obtaining metal oxide structures with improved properties.

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