Functional porous materials as enzyme support

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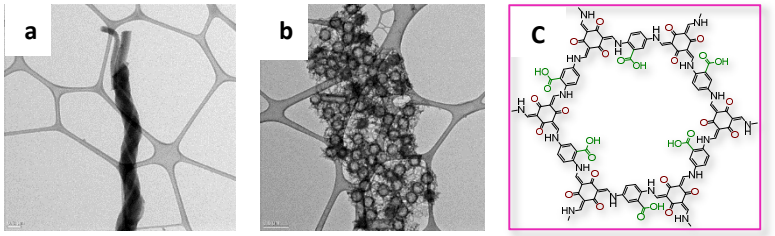
Enzymes are natural bio-macromolecules, which exhibit excellent activity and selectivity, in water and at ambient temperatures. Accordingly, they are of highest interest for the productions of industrially relevant pharmaceuticals, food additives and biofuels in an environmentally friendly manner. However, due to their delicate nature, they can just operate in a small reaction condition window, as elevated temperatures, organic solvents acid or basic media strongly influence and often deteriorate their catalytic performance. Moreover, most enzymes require a stoichiometric amount cofactor to transport electrons, hydrogen, and oxygen.

One way to increase the stability of these molecules is their immobilization on or encapsulation in a solid support. Covalent Organic Frameworks COF, are purely organic materials that exhibit long rang order, crystallinity, and high porosity. However, their use for enzyme encapsulation is limited by their small pore apertures usually not exceeding a few nanometers. We have recently developed a strategy for the fabrication of hierarchical micro/macroporous COFs, i.e., combining very small (< 2 nm) with larger pores (> 100 nm) While the large pores can host the enzyme/enzyme cofactors to prevent their denaturation, the small pores could facilitate the diffusion of substrate and products to and from the catalytic center. Furthermore, the design of new hierarchically porous COF/graphene hybrid materials as support for enzymes make them feasible for electrocatalytic reactions. The design and fabrication of these novel materials will be presented.



TEM images of (a) Pristine Tp-COOH COF (Scale bar 200nm), (b) MacroTpCOOH COF with macro pore size of 270nm (Scale bar 500nm), (C) Structure of TpCOOH COF