

## Synthesis Strategies of Functional Nanocages for Cooperative Catalysis

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Whereas cooperative effect in catalysis, in which multiple chemical interactions participate cooperatively to achieve significant enhancement in catalytic activity and/or selectivity, is common in enzymatic reactions, it has been sparingly employed in heterogeneous catalytic systems. Here, some recent literature examples of abiotic catalysis, with emphasis on heterogeneous systems, that employ cooperation between acid and base and two metal centers are briefly described to demonstrate the principles involved. Since effective cooperation places strict demand on the positions of the different functional groups, new synthetic methods and strategies are needed to design and construct structures useful for cooperative catalysis. Recent progress in synthesizing new nanocage structures that possess molecular-size cavities, atomic layer thick, porous shells with internal functional groups will be presented. These recent developments suggest possibilities of new catalytic transformations that have not been attempted before. This is illustrated with two speculative examples utilizing cooperative catalysis: oxidative hydrolytic desulfurization and terminal carbon activation of hydrocarbon molecules.