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Co-Immobilization of Palladium Nanoparticles and Polyoxometalate into the Cavities of the Mesocellular Foams: A Biomimetic Cooperative Catalytic System for Aerobic Oxidation of Alcohols under Green Conditions

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Abstract : Cooperative catalyst systems have been developed as highly promising sustainable alternatives to traditional catalysts. In these catalysts, two or more catalytic centers cooperate to reduce the energy of chemical transformations. In nature, such systems are abundantly seen in metalloenzymes that use metal and an organic cofactor. We have designed a reusable cooperative catalyst oxidation system consisting of palladium nanoparticles and polyoxometalate. This biomimetic cooperative catalytic system was synthesized by the stepwise immobilization of palladium nanoparticlesandpolyoxometalateinto the same cavity of siliceous mesocellularfoams (Pd-POM@MCF)and wascharacterizedby SEM, EDX, FT-IR, TGAand ICP techniques. POM-Pd@MCF/HQexhibits high activity toward aerobic oxidation of alcohols to the corresponding carbonyl compoundsin water solvent at room temperature. The major novelties and advantages of this oxidation method are as follows: (i) this is the first report of the co-immobilization of polyoxometalateand palladium for use as a robust and highlyefficient heterogeneouscooperative oxidative nanocatalyst system for aerobic oxidation of alcohols, (ii) oxidation of alcoholswere performed using an ideal oxidant with good to high yields in a green solvent at ambient temperature and (iii) the immobilization of the oxygen-activating catalyst(polyoxometalate) and oxidizing catalyst (Pd) onto MCF provide practical cooperative catalyst the system that can be reused several times without a significant loss of activity (vi) the methodsconform to several of the guiding principles of green chemistry.

Keywords : palladium nanoparticles, polyoxometalate, reusable cooperative catalytic system, biomimetic oxidation reaction
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