Golden Carbon Nanotube Membrane for Continuous Flow Catalysis

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Abstract

In this work, a high-performance catalytic membrane, composed of ultrasmall gold nanodusters (AuNCs) and high aspect-ratio carbon nanotubes (CNTS); was designed for the continuous flow catalytic reactions. In this hybrid catalytic membrane, the Au core of the NCs serves as high-performance catalyst, and the ligand of the NCs plays two key roles: (1) as a well-defined surfactant assembly to effectively dissolve CNTs in aqueous solution and (2) as an efficient protecting ligand for Au core to avoid agglomeration. Due to the above-mentioned features, a homogeneous 3D self-support catalytic membrane can be readily fabricated by vacuum filtration of the hybrid AuNCs/CNTs. The catalytic activity of the as-designed catalytic membrane was evaluated using 4-nitrophenol hydrogenation as a model catalytic reaction. The data suggest that the continuous flow catalytic reactor could achieve complete conversion of the substrate (i.e., 4-nitrophenol) within a single flow through the membrane with a hydraulic residence time (tau) of 3.0 s. The catalytic membrane also showed enhanced catalytic kinetics as compared to the conventional batch reactor due to the convectively enhanced mass transfer. In addition, three important parameters, including the Au loading amount, substrate concentration, and flow rate, were identified as key factors that could affect the performance of the catalytic membrane.

Keywords

KeyWords Plus: AU NANOPARTICLES; SUPPORTED AU; AU(I)-THIOLATE COMPLEXES; NANOCLUSTER CATALYSTS; METAL NANOCLUSTERS; REDUCTION; CLUSTERS; NANOSTRUCTURES; 4-NITROPHENOL; PERFORMANCE

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