Continuous synthesis of atomically dispersed Rh supported on MgAl2O4 using two-stage microreactor

Qiangqiang Xue[1], Binhang Yan[1], Yujun Wang[1], and Guangsheng Luo[1]

[1]Tsinghua University

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Abstract

Single-atom catalysts with optimal atom utilization and outstanding activity have penetrated the frontier of heterogeneous catalysis. However, the large-scale synthesis of this class of catalysts is still a bottleneck for their industrialization. Herein, we suggest a two-stage micro-dispersion approach to synthesize mesoporous MgAl2O4-supported atomically dispersed Rh, which is more competitive than the batch method for boosting the uniform dispersion of Rh. By increasing the Rh loading, single-atom catalysts (SACs, $<$ 0.05wt%), single-atom catalysts + nanoparticle catalysts (0.05–0.17 wt%), and nanoparticle catalyst (NPCs, 0.17–1.10 wt%) were obtained. For n-octane steam reforming, the turnover frequency of the SAC (0.01 wt%) was approximately 30 times that of the NPC (1.10 wt%), while the Rh amount of the SAC was only 3% that of the NPC for the same fuel conversion. Under a high-temperature (750) steam atmosphere for 15 h, the hydrogen formation rate only declined from 25.1 to 23.8 mol/mol-C8H18.

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