H_2S Oxidation over Atomic Cobalt Modified Nitrogen-Rich Hierarchical Porous Carbon Nanofibers: Efficient Desulfurization and High-Performance Li-S Batteries

Minghui Sun, Xuzhen Wang,* Xin Pan, Yong Li, Zongbin Zhao, Jieshan Qiu

State Key Lab of Fine Chemicals, School of Chemical Engineering, Liaoning Key Lab for Energy Materials and Chemical Engineering, Faculty of Chemical, Environmental and Biological Science and Technology, Dalian University of Technology, Dalian 116024, China.

E-mail: xzwang@dlut.edu.cn

ABSTRACT

Cobalt atoms modified nitrogen-rich hierarchical carbon nanofibers (CoN-MCNFs) with an efficient activity for the selective oxidation of H_2S have been constructed through the combination of electrospinning and carbonization. The doped atomic cobalt/nitrogen content, the specific surface area (S_{BET}) and the ratio of micropore to mesopore of CoN-MCNF hybrids can be readily adjusted by tuning the experimental parameters, including the proportion of Co in Zn,Co-ZIF, the ratio of PAN to Zn,Co-ZIF in precursors and the carbonization temperature, as well as the activation by KOH. Thanks to their unique hierarchical porous structures and the co-doping of Co and N, the as-obtained CoN-MCNF hybrids exhibit superior sulfur capacity (4.69 g H_2S/g cat.) and higher selectivity for the oxidation of H_2S into elemental sulfur at room temperature, compared with the original CNFs and microporous carbon derived from direct carbonization of Zn,Co-ZIF. More interestingly, owing to the novel structures and high sulfur loads, the spent CoN-MCNF catalysts can be further applied as a cathode in lithium-sulfur battery (LSB) and exhibits a high Coulombic efficiency, good rate capability, as well as preferable cycling stability. This strategy opens up a new avenue to fabricate heterogeneous nanocatalysts for the efficient removal of pollutants and the creation of novel materials for high-performance energy storage.

KEYWORDS: H_2S oxidation; Porous carbon nanofibers; Cobalt and Nitrogen co-doping; Electrospinning method