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Ordered mesoporous $NiFe_2O_4$ with ultrathin framework for low-ppb toluene sensing

Xiaoyong Lai*[a], Kun Cao[a], Guoxin Shen[a], Ping Xue[a], Dan Wang*[b], Fang Hu[c], Jianli Zhang [a], Qingfeng Yang [a], Xiaozhong Wang[a]

[a]*State Key Laboratory of High-Efficiency Utilization of Coal and Green Chemical Engineering, School of Chemistry and Chemical Engineering, Ningxia University, Yinchuan 750021, China.*

[b]*State Key Laboratory of Biochemical Engineering, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100190, China.*

[c]*School of Materials Science and Engineering, Shenyang University of Technology, Shenyang 110870, China*.

Corresponding Authors: Email: xylai@nxu.edu.cn (Lai X.); danwang@ipe.ac.cn (Wang D.)

Abstract

Highly sensitive and selective detection against specific target gases, especially at low-ppb (part per billion) level, remain a great number of challenges in gas sensor applications. In this paper, we first present an ordered mesoporous $NiFe_2O_4$ for highly sensitive and selective detection against low-ppb toluene. A series of mesoporous $NiFe_2O_4$ materials were synthesized by templating from mesoporous silica KIT-6 and its framework thickness was reduced from 8.5 to 5 nm by varying the pore size of KIT-6 from 9.4 to 5.6 nm, accompanied with the increase of the specific surface area from 134 to 216 $m^2 g^{-1}$. The ordered mesoporous $NiFe_2O_4$ with both ultrathin framework of 5 nm and large specific surface area of up to 216 $m^2 g^{-1}$ exhibits a highest response ($R_{gas}/R_{air}-1=77.3$) toward 1,000 ppb toluene at 230 °C and is nearly 7.3 and 76.7 times higher than those for the $NiFe_2O_4$ replica with thick framework and its bulk