

Accepted Manuscript

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PII: S2095-9273(18)30015-X
DOI: <https://doi.org/10.1016/j.scib.2018.01.015>
Reference: SCIB 320

To appear in: *Science Bulletin*

Received Date: 31 October 2017
Revised Date: 27 November 2017
Accepted Date: 21 December 2017

Please cite this article as: X. Lai, K. Cao, G. Shen, P. Xue, D. Wang, F. Hu, J. Zhang, Q. Yang, X. Wang, Ordered mesoporous NiFe₂O₄ with ultrathin framework for low-ppb toluene sensing, *Science Bulletin* (2018), doi: <https://doi.org/10.1016/j.scib.2018.01.015>

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Ordered mesoporous NiFe₂O₄ with ultrathin framework for low-ppb toluene sensing

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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 NiFe₂O₄ for highly sensitive and selective detection against low-ppb toluene. A series of mesoporous NiFe₂O₄ 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 m² g⁻¹. The ordered mesoporous NiFe₂O₄ with both ultrathin framework of 5 nm and large specific surface area of up to 216 m² g⁻¹ exhibits a highest response ($R_{\text{gas}}/R_{\text{air}}-1=77.3$) toward 1,000 ppb toluene at 230 °C and is nearly 7.3 and 76.7 times higher than those for the NiFe₂O₄ replica with thick framework and its bulk

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