
Title: Tailoring thermal conductivity of bulk graphene oxide by tuning the oxidation degree

Authors: Qing-Long Meng, Hengchang Liu, Zhiwei Huang, Shuang Kong, Peng Jiang, Xinhe Bao

PII: S1001-8417(17)30445-X
DOI: https://doi.org/10.1016/j.cclet.2017.10.028
Reference: CCLET 4301

To appear in: *Chinese Chemical Letters*

Received date: 29-6-2017
Revised date: 20-9-2017
Accepted date: 25-10-2017

Please cite this article as: Qing-Long Meng, Hengchang Liu, Zhiwei Huang, Shuang Kong, Peng Jiang, Xinhe Bao, Tailoring thermal conductivity of bulk graphene oxide by tuning the oxidation degree, Chinese Chemical Letters https://doi.org/10.1016/j.cclet.2017.10.028

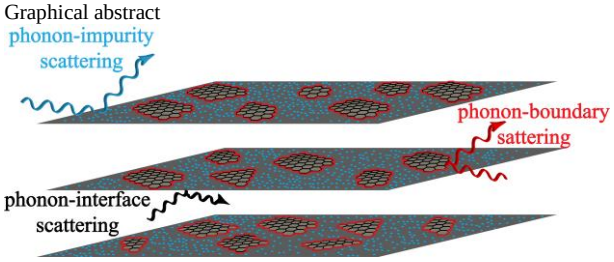
Communication

# Tailoring thermal conductivity of bulk graphene oxide by tuning the oxidation degree

Qing-Long Meng[a], Hengchang Liu[a,b], Zhiwei Huang[a,c], Shuang Kong[a,c], Peng Jiang[a,*], Xinhe Bao[a,*]

[a]*State Key Laboratory of Catalysis, CAS Center for Excellence in Nanoscience, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Dalian 116023, China*
[b]*School of Physical Science and Technology, ShanghaiTech University, Shanghai 200031, China*
[c]*University of Chinese Academy of Sciences, Beijing 100039, China*

Graphical abstract




The thermal conductivity of graphene oxides can be tailored by tuning oxidation degree due to the introduction of atomic- and nano-scale phonon scattering centers.

ARTICLE INFO

*Article history:*
Received 30 June 2017
Received in revised form 21 September 2017
Accepted 26 September 2017
Available online

*Keywords: Graphene oxide*
Thermal conductivity
Scattering center
Anisotropy
Oxidation degree

ABSTRACT

Bulk graphene oxide (GO) shows great potential in a variety of applications, such as sensors, photodetectors, supercapacitors, lithium ion batteries and catalysts. However, its thermal conductivity, one of the most important and fundamental physical properties, is still less known. Herein, we have systematically investigated the thermal conductivity of bulk GOs and find that it can be tailored by tuning their oxidation degree during preparation process. Notably, the cross-plane thermal conductivity of bulk GO, in comparison with its precursor graphite, exhibits more than 100 times decrease at room temperature. The dependence of thermal conductivity of GO on oxidation degree is attributed to the chemical and structural changes by introducing oxygen atoms and oxygen-containing functional groups, which can lead to a significant enhancement in atomic- and nano-scale phonon scattering. Furthermore, we reveal that the thermal conductivity of bulk GOs exhibits evident anisotropic behavior. These results provide fundamental understanding and valuable information on thermal transport properties of bulk GOs for various practical applications.

Heat management is a crucial issue in modern electronic industry, which requires thermal conductivity as high as possible to maintain system's long-life service and reliability [1,2]. On the other hand, thermal insulation for energy-efficient buildings [3,4] and thermoelectrics [5-7] needs thermal conductivity to be as low as possible to achieve high performance. Therefore, the development and search for materials with tunable thermal conductivity is of great significance for multiple practical applications such as electronics, energy-efficient buildings and thermoelectrics.

Graphene oxide (GO) has attracted tremendous interest due to its unique properties. Its tunable properties like hydrophobicity/ hydrophilicity [8,9], electrical conductivity [10-12] as well as band gap [13,14] can be readily achieved by tuning the ratio of $sp^2$ to $sp^3$ bonded carbons, which makes it promising for a variety of applications such as sensors [15], photodetectors [16], supercapacitors [17], lithium ion batteries [18,19] and catalysts [20,21]. The

* Corresponding authors.
*E-mail addresses:* pengjiang@dicp.ac.cn (P. Jiang), xhbao@dicp.ac.cn (X.H. Bao)