Stepwise Reduction of Immobilized Mono layer Graphene Oxides - DTU Orbit (30/12/2018)

Stepwise Reduction of Immobilized Mono layer Graphene Oxides

Chemically converted graphene is highly relevant for transparent conducting film applications such as display and photovoltaic uses. So far, the major obstacle for realizing the potential has been to fully reduce/deoxygenate the graphene oxide (GO), which is challenging in part due to the pronounced aggregation that accompanies deoxygenation of GO in solution. Surface immobilization of monolayered graphene oxide (mGO) in Langmuir-Blodgett (LB) films was investigated as a method to circumvent this problem. Two types of LB films with different density of mGO flakes were prepared, i.e., diluted and coherent, and efficiently deoxygenated in a three-step reduction procedure involving subsequent treatment with hydrazine in dimethylformamide (DMF), sulfuric acid, and high temperature annealing. The stepwise reduction process was evaluated with optical microscopy, Raman microscopy, X-ray photoelectron spectroscopy (XPS) along with electrical characterization. XPS measurements confirmed a full conversion into virtually oxygen-free chemically converted graphene. The electrical characterization revealed large variations in the conductivity for single sheets in the diluted LB films, with an average conductivity of 100 S/cm. A similar conductivity was found for macroscopic devices made from the coherent LB films with overlapping mGO sheets. The large variation in single sheets conductance is assigned to overoxidation of the GO leading to formation of holes, which cannot be recovered in the chemical reduction procedure. The study shows that the applied three-step reduction procedure is chemically complete and that the conductivity of this chemically converted graphene is limited by structural defects/holes rather than remaining oxygen functionalities.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Nanointegration, Chinese Academy of Sciences, University of Copenhagen
Contributors: Petersen, S., He, Y., Lang, J., Pizzocchero, F., Bovet, N., Bøggild, P., Hu, W., Laursen, B. W.
Number of pages: 10
Pages: 4839-4848
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: Chemistry of Materials
Volume: 25
Issue number: 24
ISSN (Print): 0897-4756
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 9.74 SJR 4.675 SNIP 1.896
Web of Science (2017): Impact factor 9.89
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 8.89 SJR 4.136 SNIP 1.883
Web of Science (2016): Impact factor 9.466
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 9.38 SJR 3.958 SNIP 2.061
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 8.89 SJR 3.595 SNIP 2.222
Web of Science (2014): Impact factor 8.354
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 8.94 SJR 3.666 SNIP 2.267
Web of Science (2013): Impact factor 8.535
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): CiteScore 8.1 SJR 4.181 SNIP 2.247