Study on Carbon Structural Changes in Manganese Dioxide/Graphene composites prepared by direct redox deposition

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Abstract

Structural changes of the carbon in a MnO_2/reduced graphene oxide (RGO) hybrid materials prepared by the direct redox reaction between carbon and permanganate ions (MnO_4^-) were explored to reach better understaning for the effects of carbon corrosion on carbon loss and its bonding nature during the hybrid synthesis. We have demonstrated the changes in the RGO structure that occur during synthesis of MnO_2/RGO hybrids by the direct redox deposition of MnO_2 onto RGO. Our results demonstrate that the redox reaction between MnO_4^- ions and RGO gives rise not only to quantitative carbon loss but also to changes in the electronic structure of the carbon remaining after the redox deposition of MnO_2. The direct redox deposition of MnO_2 onto RGO, which is a carbon-destructive approach, leads to a substantial carbon loss from the initial RGO structure, as evidenced in our EA results. In addition, C K-edge NEXAFS results suggest that there is an oxidized carbon environment at the interface within the hybrids that results in a localized electronic structure of the RGO remaining in the R-MnO_2/RGO hybrid after the carbon loss during redox deposition of MnO_2. Therefore, disruption of the sp^2 carbon bonding of the RGO and strong Mn-O-C covalent bonding interactions between the MnO_2 and RGO in the R-MnO_2/RGO hybrids may have a detrimental effect on the electrical properties of the hybrids. Electrochemical measurements of the MnO_2/reduced graphene oxide hybrid using a Cavity Micro Electrode revealed unfavorable electrochemical properties mainly due to the poor electrical conductivity of the hybrid. This study provides a useful guide for a rational approach to synthesizing metal/RGO or metal oxide/RGO hybrid materials

References

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Figures

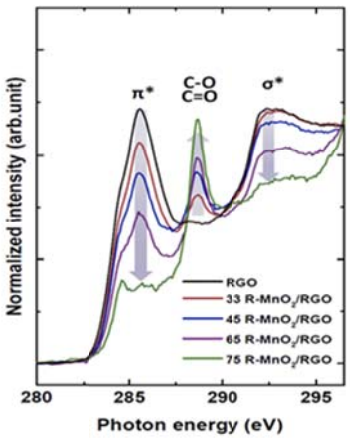

Fig1. Normalized NEXAFS spectra for R-MnO_2/RGO hybrids with various MnO_2 contents and the RGO precursor