Carbon Electrode Materials For Electrochemical Sensing Of Nitrogen Dioxide And Ozone

Andi Wang , D.D.L. Chung, Mark Wagner
University at Buffalo, State University of New York

INTRODUCTION

The project will involve the development of nanostructured carbon materials for use in electrochemical sensors, which in turn will be used for personal Air Quality Index (AQI) monitors. To accomplish this, the Composite Materials research Lab (CMRL) at SUNY Buffalo will work with Sensorcon to test these carbons in sensors connected to the Sensordrone personal sensor platform, which combines environmental sensors with smartphones.

TECHNOLOGICAL OBJECTIVES

- Fabricate and characterize nanostructured carbon materials for electrochemical sensors. Compare performance with expensive technologies/official monitoring stations.
- Enable citizen monitoring of air quality index via low-power next-generation sensors and smartphones.

SCIENTIFIC OBJECTIVES

✓ To develop carbon electrode materials for sensing various pollutants, particularly NO_2 and O_3.

✓ To develop sensors which utilize the carbon electrode materials

METHODOLOGY

◆ Combine gas sensor technologies with GPS-enabled smartphones. This approach will enable citizens to share the air quality index (AQI) data of their location over the internet, resulting in far greater geographic coverage than today, and major policy implications.

◆ Tailor carbon electrodes for selective gas sensing through physical and chemical modification.

SCIENCE BEHIND

Activation:

$$6KOH + C \leftrightarrow 2K + 3H_2 + 2K_2CO_3$$ [2]

The activation process is to "etch" the carbon surface in a nano and narrow way, which provides more surface area and suitable shape to catch the gas atoms.

Sensing Electrode:

$NO_2 + 2H^+ + 2e^- \xrightarrow{C} NO + H_2O$

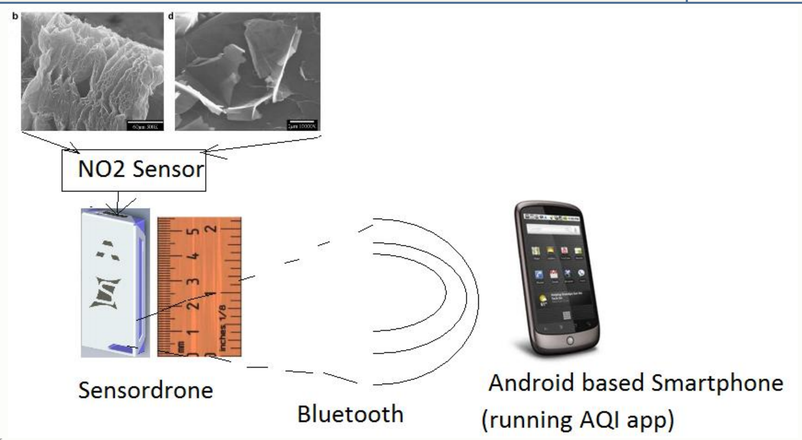
$O_3 + 2H^+ + 2e^- \xrightarrow{C} O_2 + H_2O$

Counter Electrode:

$H_2O \rightarrow 1/2O_2 + 2H^+ + 2e^-$

KEY CHARACTERISTICS

Surface microstructure ----------SEM
Pore size distribution ----------BET
Chemistry and surface functional groups---------ESCA
Crystallinity ----------XRD
Electrolyte absorptivity
Electrical conductivity
Electrochemical behavior by
Cyclic voltammetry
AC impedance spectroscopy----------Nyquist plots



APPROACH

- Carbon Materials offer better selectivity for Oxidizing gases over noble metals like platinum. Processes that can tune the surface structure can further enhance selectivity and sensitivity
- Heat treatment
- Chemical treatment
- Activation to various degrees
- Graphitization to various degrees

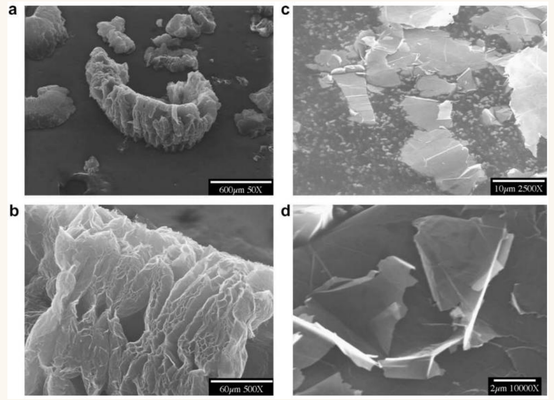


Fig. 1 SEM photographs. (a) and (b) Exfoliated graphite before sonication. (c) and (d) Graphite nanoplatelets obtained by sonication of exfoliated graphite[1].

ACKNOWLEDGEMENT

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REFERENCE

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