Investigation of Wetting Properties of Few Layers of Graphene Sheets Prepared by Electrochemical Method

Injamul Alam, Kadambinee Sa, Sonali Das, BVRS Subramanyam, Jagatpati Raiguru, Manoranjan Mandal, Subhasri Subudhi and Pitamber Mahanandia*

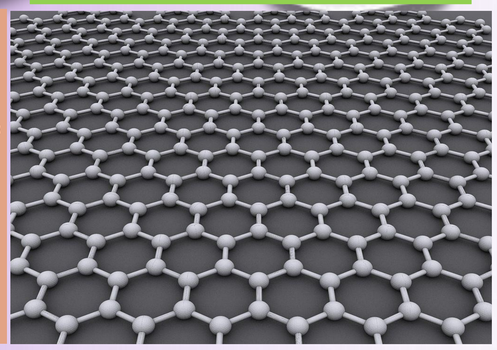
Dept. of Physics & Astronomy

National Institute of Technology, Rourkela

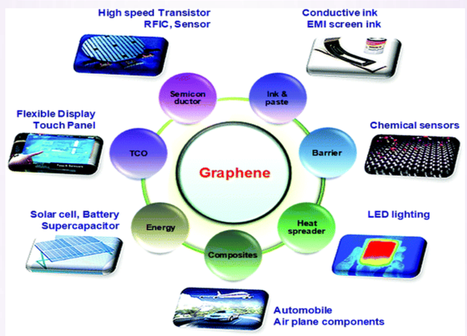
INTRODUCTION

- 2-dimensional, crystalline allotrope of carbon
- Allotrope: property of chemical elements to exist in two or more forms
- Single layer of graphite
- Honeycomb (hexagonal) lattice

GRAPHENE



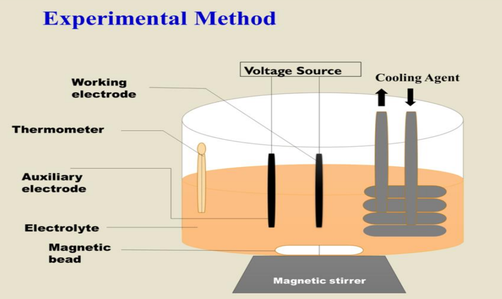
APPLICATIONS



METHODS

- Mechanical exfoliation
- Epitaxial growth
- Chemical vapour deposition
- Microwave method
- Electrochemical method

ELECTROCHEMICAL METHOD



OBJECTIVES:

- Trying to investigate the wetting properties i.e. hydrophobic or hydrophilic of FLGS prepared by electrochemical method depends on the nature of substrates.
- The hydrophobic or hydrophilic of FLGS has been carefully examined by correlating measured electrical properties i.e. the current-voltage(I-V) characteristics in the presence of water drop of FLGS for the various applications.

RESULTS

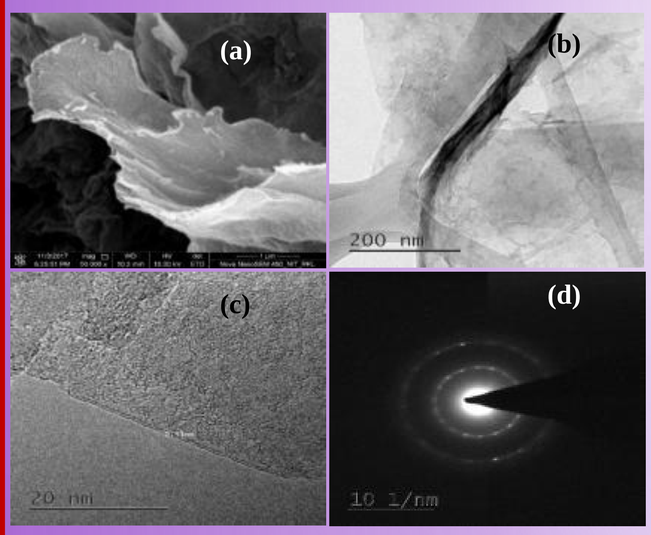


FIG. 1.(a) FESEM, (b) TEM, (c) HRTEM images and (d) SAED pattern of FLGS.

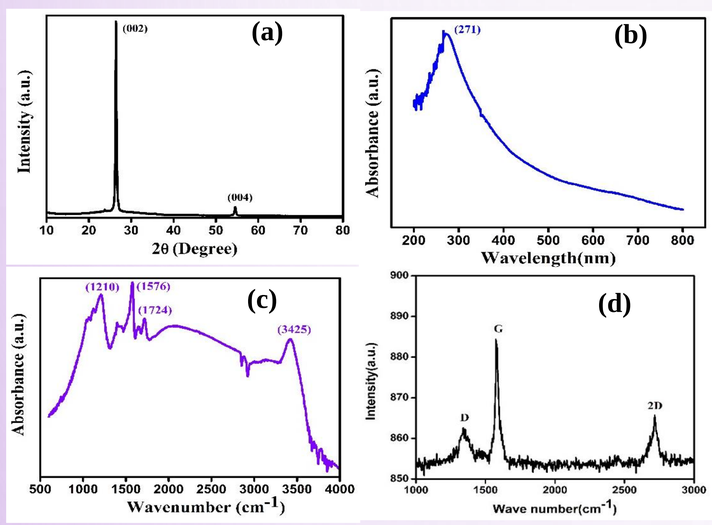
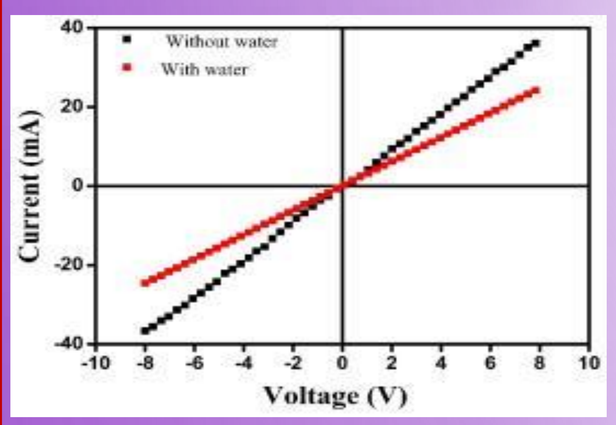
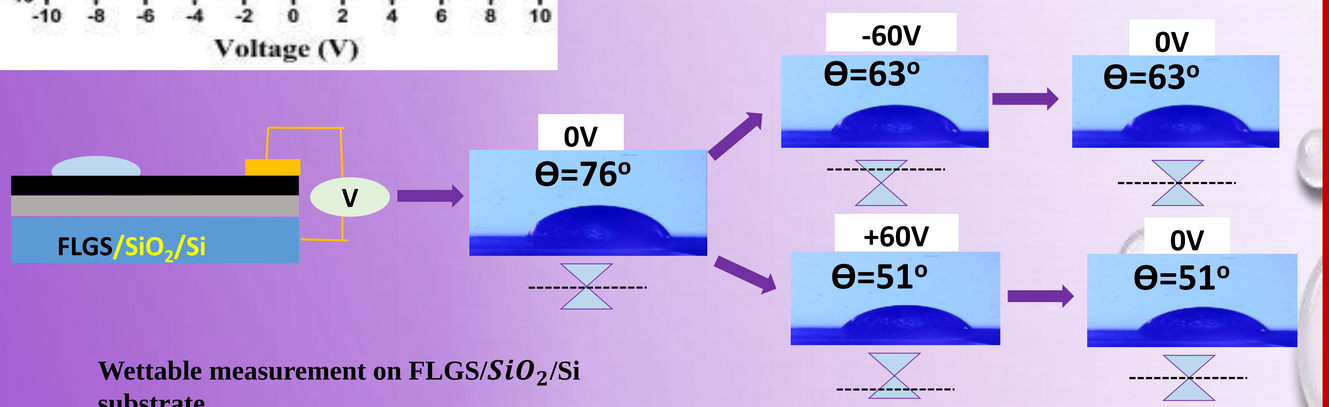


FIG. 2. (a) XRD pattern, (b) UV-Vis, (c) FTIR and (d) Raman spectra of FLGS



I-V Characteristics of FLGS with and without water



Wettable measurement on FLGS/SiO_2/Si substrate

Wettable measurement on SiO_2/Si surface at different voltages (−60 V/0 V/+60 V)

DISCUSSIONS

- From FESEM image, it is seen that the as prepared graphene sheets are well exfoliated.
- The HRTEM image reveals that the graphene sheets are mostly bi layers with 0.51nm inter layer distance. In SAED picture, the distinct and clear presence of spot diffraction ring pattern indicates the crystallinity nature of as prepared FLGS.
- The XRD pattern of FLGS assured the crystalline structure which shows a sharp diffraction peak at 26.34°.
- UV-Vis absorption spectrum of FLGS shows the absorption peak at 271 nm corresponding to C=C bonds admit that there is no other functional group.
- FTIR Spectrum of FLGS shows a broad band around 3300-3500 cm^{-1} corresponding to the signature of υ (OH) stretching vibration coming from adsorbed H2O molecules and a peak at 1576 cm^{-1} relates to C=C bond.
- Raman spectra of FLGS shows two prominent peaks at ~1340 cm^{-1} and ~1574 cm^{-1} corresponding to G band and D band. Here, I_{2D}/I_G and I_G/I_D is found to be ~1 and ~0.97 respectively indicating the as prepared graphene is of few layers and good quality in nature.
- The CA of FLGS/SiO_2/Si was obtained at 76° without any bias voltage, which asserts that the hydrocarbon adsorption is saturated
- Both the negative and positive voltage asserts to a heavy collision between water and FLGS.
- WCAs on SiO_2/Si remained the equal values after using the bias voltages (−60 V/0 V/+60 V).
- The obtained result approve the theory which states that the wettable properties of FLGS is associated with its Fermi level state but it is not associated with charge trapping among the adsorbed hydrocarbons on FLGS and water
- From the Current (I)– Voltage (V) characteristics of FLGS, in the presence of water drop, water molecules are absorbed by the few layer of graphene sheets and as a result the resistance of FLGS increases i.e. current decreases.

CONCLUSIONS

- We have successfully prepared few layers of graphene by electrochemical method.
- It has been observed that the hydrophilicity of graphene does not directly depend on the substrate.
- The wettability of graphene provides a wide variety of application areas, ranging from the electrochemical to biomedical.

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