UNIVERSITY OF LAGOS

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Synthesis of Graphene Oxide from Coconut Shell Particles using the Improved Tour's Method

Presented

by

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Introduction

- Graphene Oxide (GO) is one of the most flexible nanomaterials that has developed because of its special structure and characteristics.

- In contrast to pure graphene, which is highly conductive and non-reactive, GO has oxygen functional groups (hydroxyl, epoxy, and carboxyl) that break the *sp* network of the crystal.

- These compounds render GO water soluble, reactive, and dissolvable in water so that it can be utilized in composites, membranes, sensors, and energy devices

Statement of the Problem

- Commercial grade Graphene Oxide are expensive nanomaterials averaging about $200 per gram.
- The conventional production methods of GO is characterized by serious limitations.
- The prevalent production techniques such as the Brodie, Hummers and Staudenmaier methods are often accompanied by the emission of hazardous Chlorine dioxide (ClO2), NO_2 and N_2O_4 gases.
- Coconut shells which can serve as a source of rich carbon are readily available and disposed indiscriminately across Nigeria.

Materials and Methods

- Materials used:
  a) Coconut shell particles
  b) Hydrochloric acid
  c) Distilled water
  d) Hyrofluoric acid
  (e) Potassium permangranate
  (f) Potassium Hydroxide (KOH)
- Methods: Preparation of Activated Coconut Shell Graphite

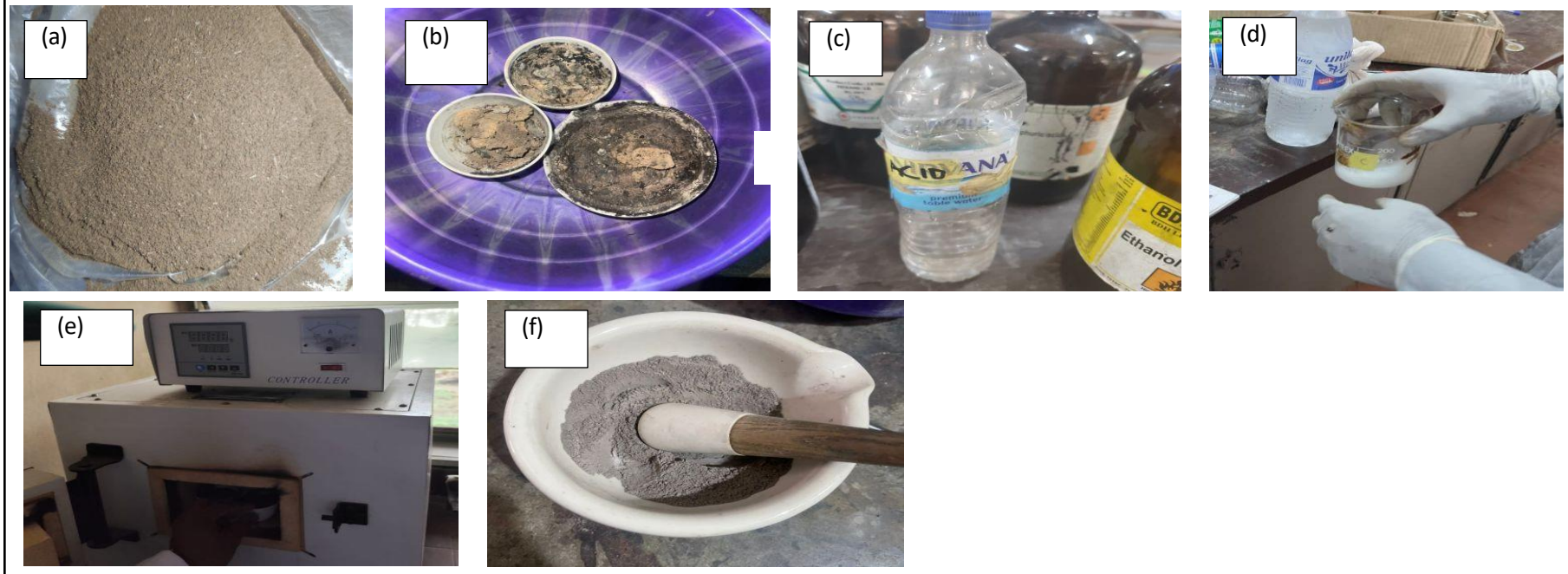


Figure 1: Preparation of graphite powder from coconut shells. (a) Preparation of graphite powder from coconut shells. (a) Sample preparation (b) Carbonization at 600 oC (c) Acid washing (d) Activation with KOH (e) Oven Drying at 110 oC (f) ACSG

Methods cont'd



Figure 2. Synthesis of Graphene Oxide using the Improved Tour method (a) Preparation (b) Controlled Oxidation (c) Post-Oxidation (d) Separation using Centrifuge (e) Washing with HCL and Ethanol (f) Vacuum drying (g) Graphene Oxide

○Characterization

- ○XRD was carried out to identify phases present
- ○FTIR to establish the presence of oxygen-containing functional groups
- ○SEM/EDX used to examine morphology and obtain supporting elemental composition
- ○Raman Spectroscopy: provides information about its graphitic arrangements, structural defects, flaws, degree of disorder, as well changes in the carbon lattice as a result of oxidation.

(c)

Results and discussion: XRD

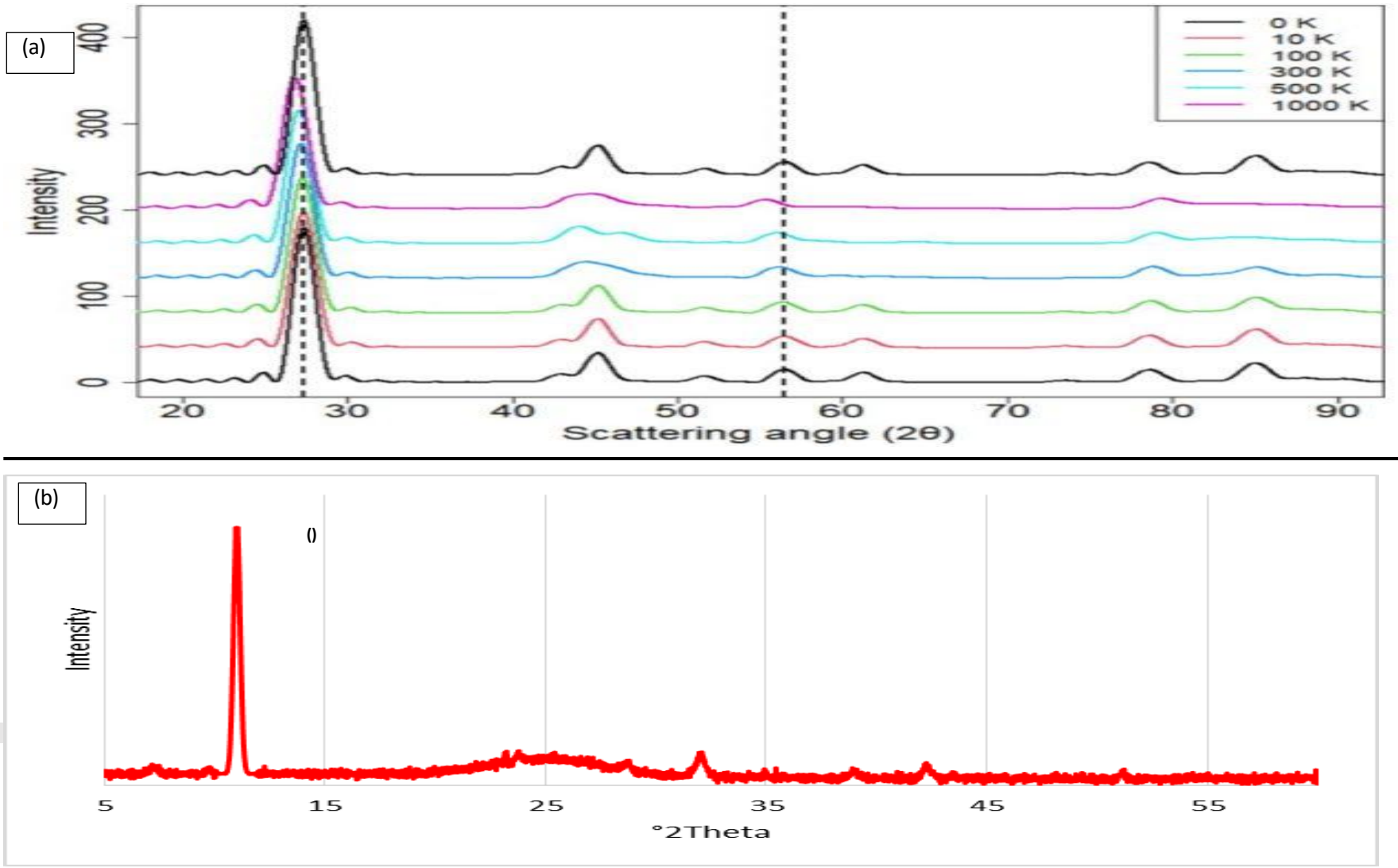


Figure 3: Representative XRD micrographs of Graphene Oxide

FTIR

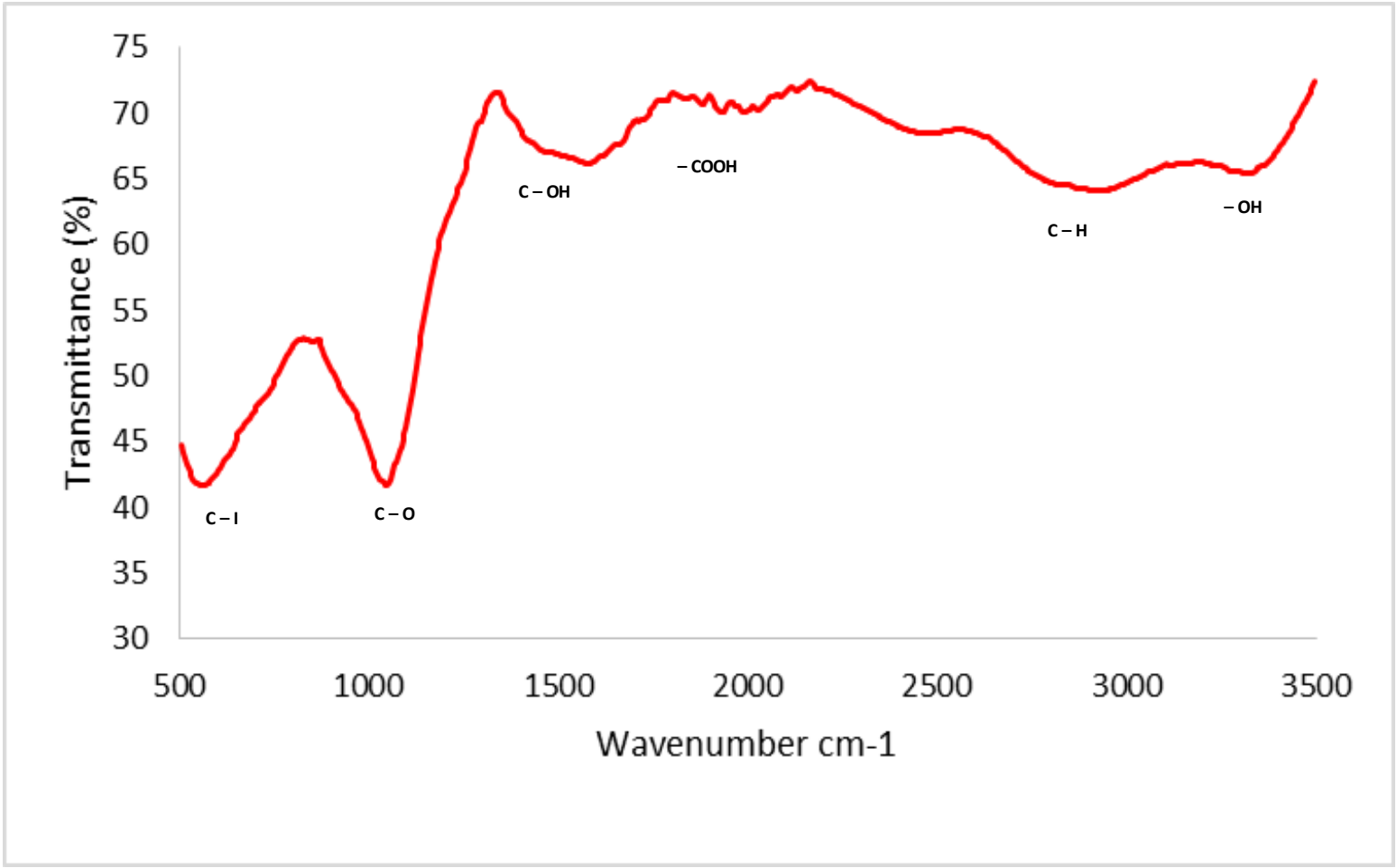
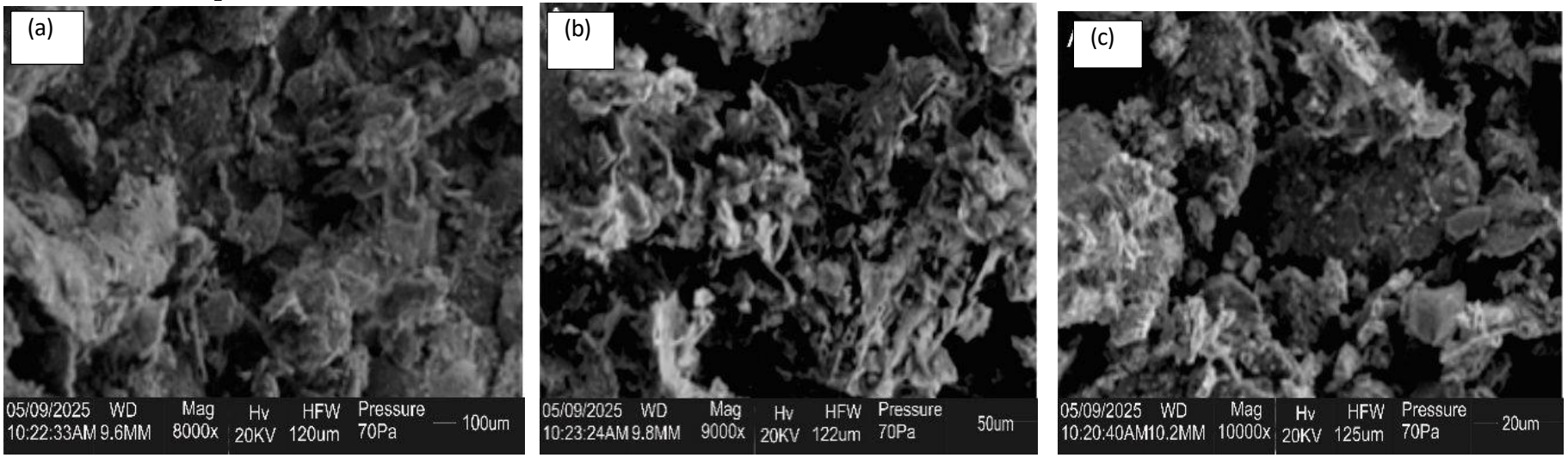
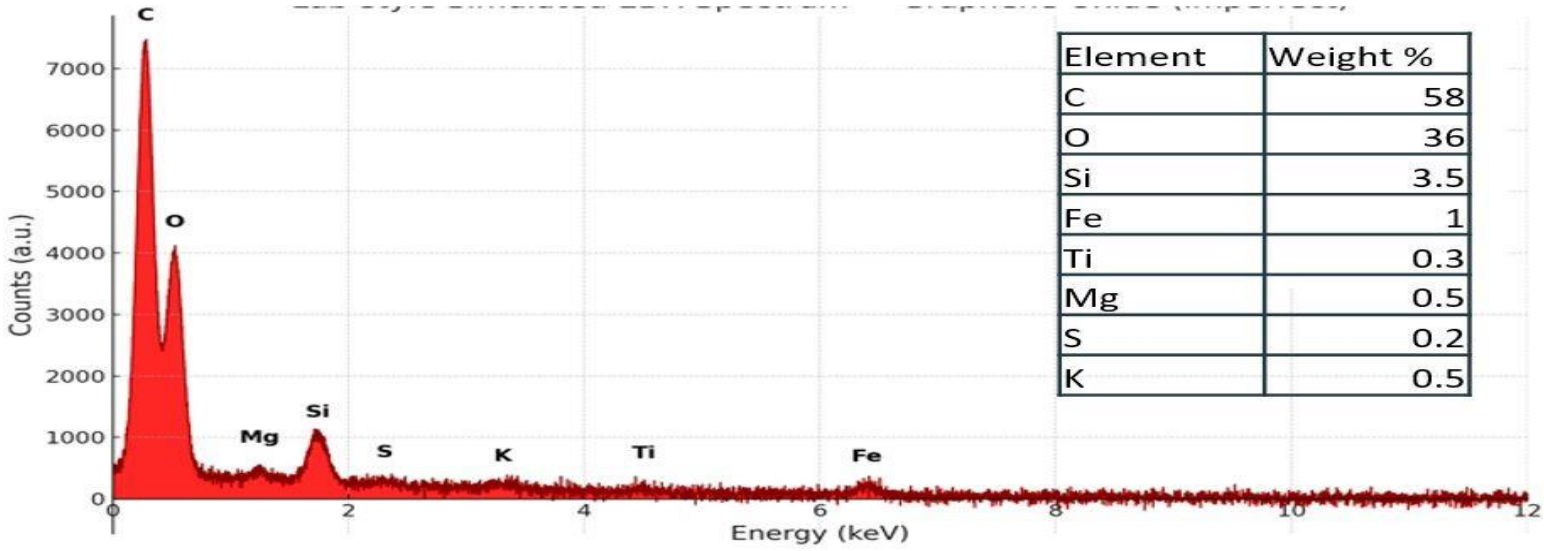


Figure 4: Representative Raman Spectrum of Graphene Oxide

SEM/EDX



Representative SEM micrographs of the Graphene Oxide (GO)



Element	Weight %
C	58
O	36
Si	3.5
Fe	1
Ti	0.3
Mg	0.5
S	0.2
K	0.5

Representative TGA thermogram of treated composite samples

Raman Spectroscopy

(a)

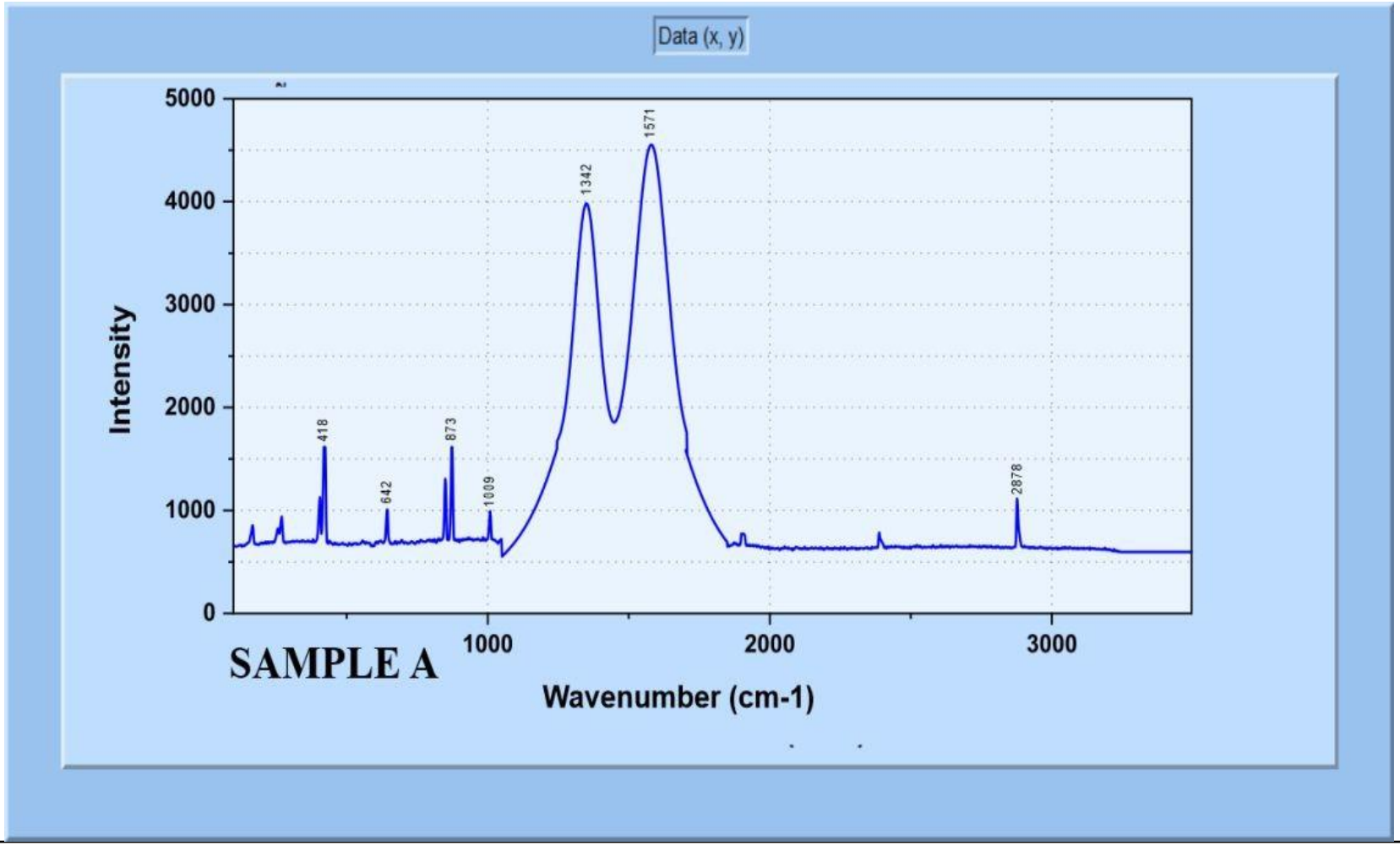


Figure 5: Representative Raman Spectrum of Graphene Oxide

Findings

- XRD displayed the disappearance of the graphite (002) peak and the emergence of the characteristic GO peak at ~11°, confirming increased interlayer spacing.
- FTIR further confirmed the presence of oxygen-containing groups such as carboxyl, carbonyl, hydroxyl groups around and functionalities at 1620, 1720, 3400 cm-1 bands, respectively. In the same vein, alkoxy and epoxy groups were identified 1050, 1220 cm-1 bands, respectively.
- The SEM micrographs revealed a sheet-like and wrinked morphology which is characteristic of Graphene Oxide while the EDX micrographs revealed 58% carbon content and 36% oxygen which confirms effective oxidation process over raw graphite
- In the same vein, the Raman spectrum characteristically shows two vibrational modes of graphene-based substances, namely the D and G bands.

Conclusion

- This study successfully demonstrated that coconut shells can serve as an effective and sustainable carbon precursor for the production of graphene oxide using the Improved Tour method.
- The carbonization, purification, and controlled oxidation steps resulted in a material whose structural, chemical, and morphological characteristics are consistent with established graphene oxide properties. The characterization results collectively confirmed the successful synthesis.