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Synthesis and characterization of reduced graphene oxide from pomegranate peels, banana peels, cotton wastes and corn leaves

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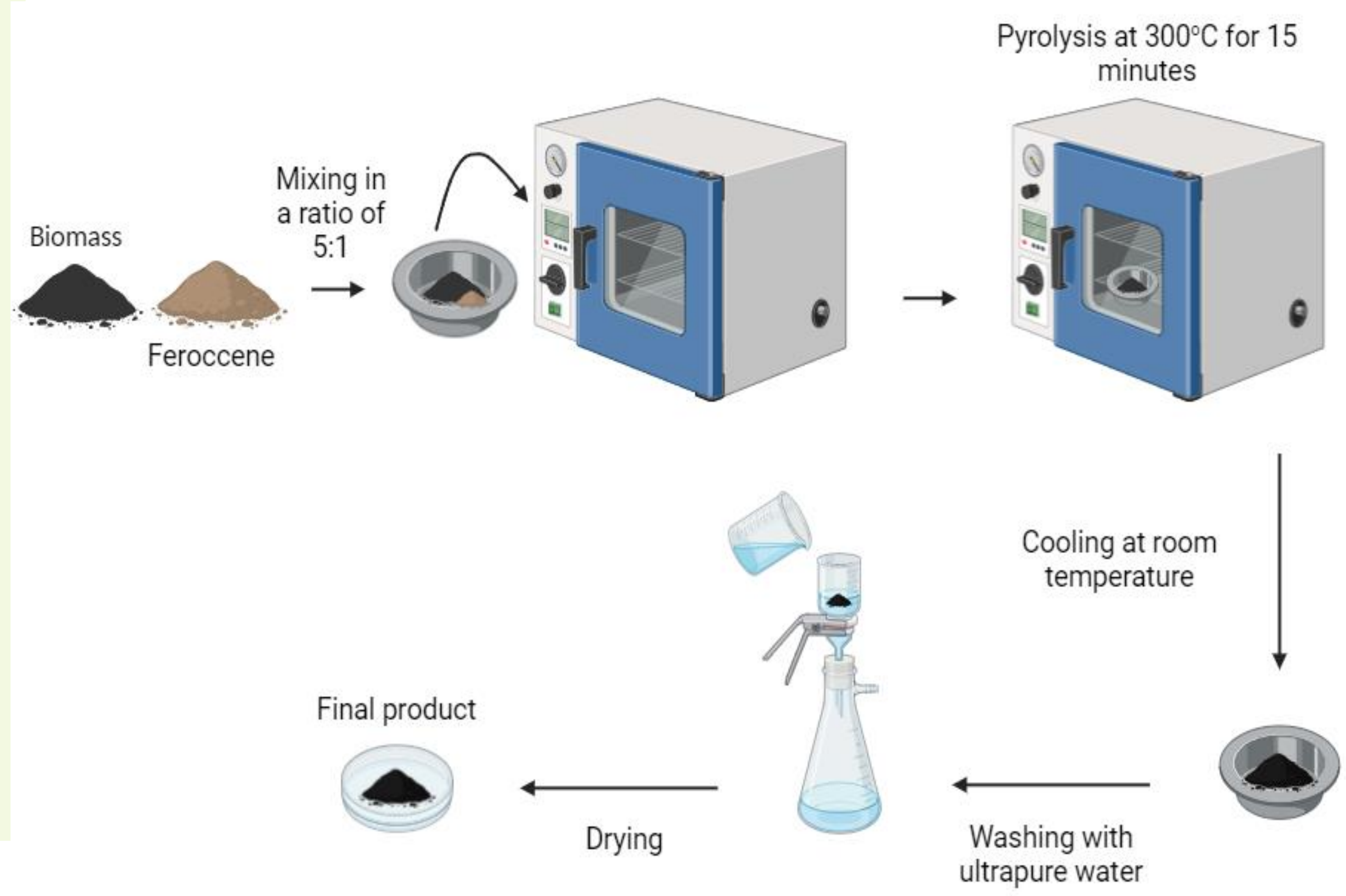
1. INTRODUCTION

Agricultural wastes are produced in large quantities every year worldwide. Therefore, using them to create valuable goods is vital to achieve environmental sustainability. In order to meet the increasing demand while keeping production costs low, a variety of waste from carbon sources are now being aimed to be converted into important nanomaterials. The present research focuses on the use of different biomasses as a carbon source for the production of reduced graphene oxide (rGO) using ferrocene as a catalyst. Ferrocene is an orange-colored organometallic compound which creates extensive structural changes in carbon materials, promoting the oxidation of porous carbon to graphene-like formations with sp^2 hybridization, as expected for rGO. In this study, 4 different biomasses were used, specifically banana and pomegranate peels, corn leaves and cotton wastes. Through the use of the ferrocene as catalyst, and the pyrolysis process, the production of rGO was achieved.

2. EXPERIMENTAL



3. RESULTS

Characterization of the structure

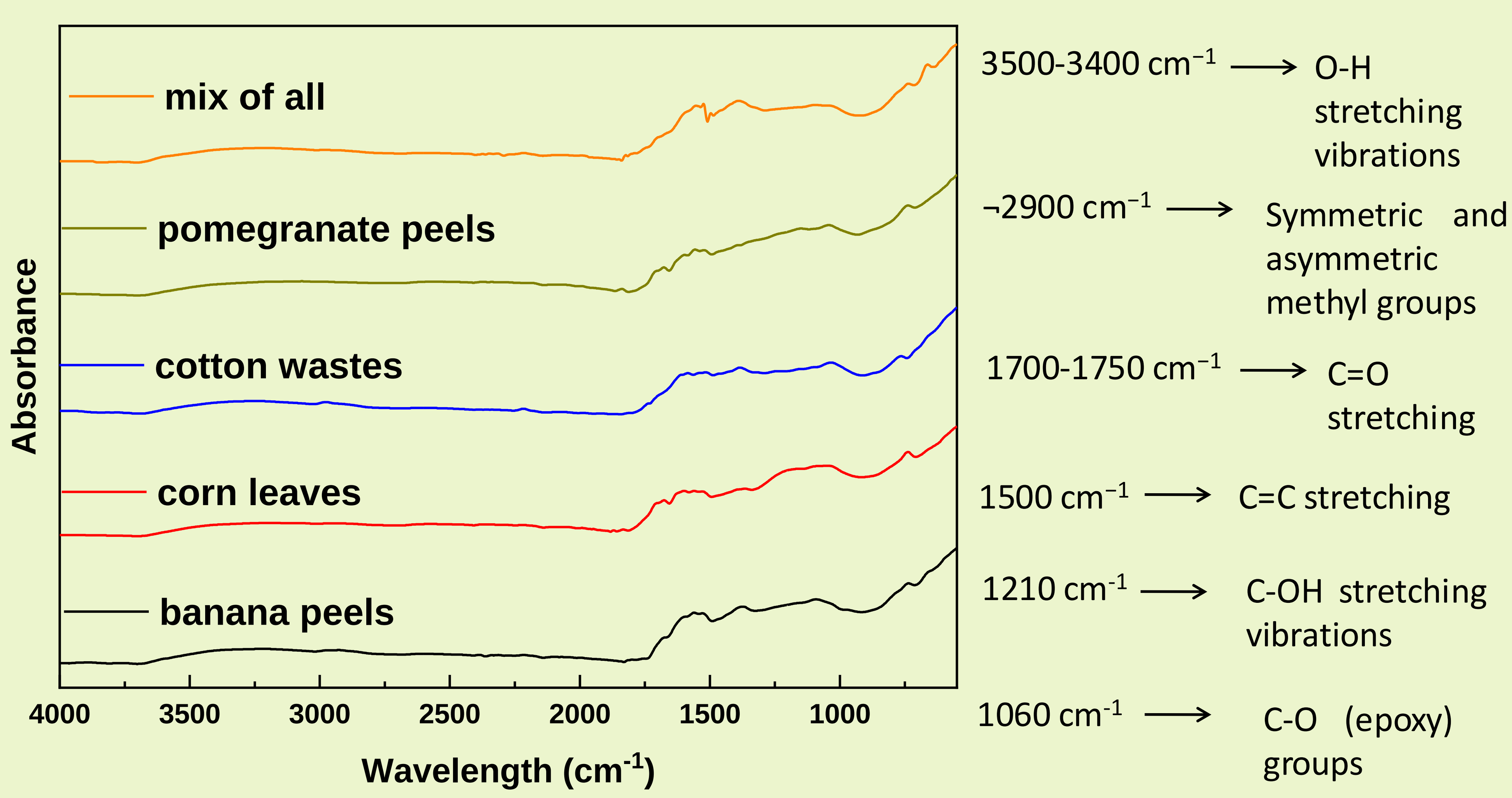


Figure 1. FTIR diagram of rGO derived from biomasses

Crystallinity study

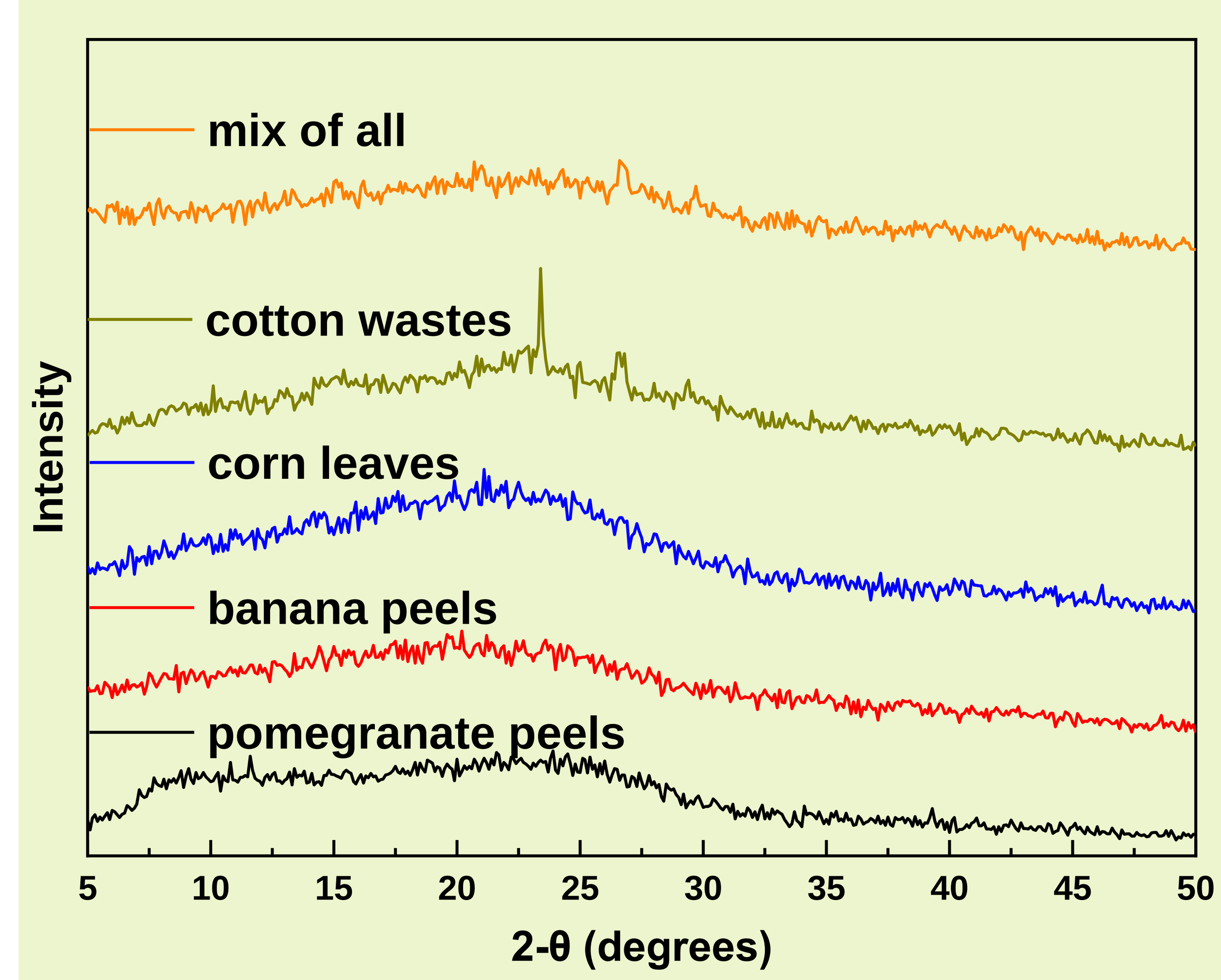


Figure 2. XRD diagram of rGO derived from biomasses

rGOs derived from different biomasses present a broad peak centered at 2θ=21.2-24.2°. This shows the crystalline structure of rGO.
These peaks correspond to the reflection of the (002) plane of rGO, indicating the production of rGO, a few-layer graphene structure.

Morphological characterization

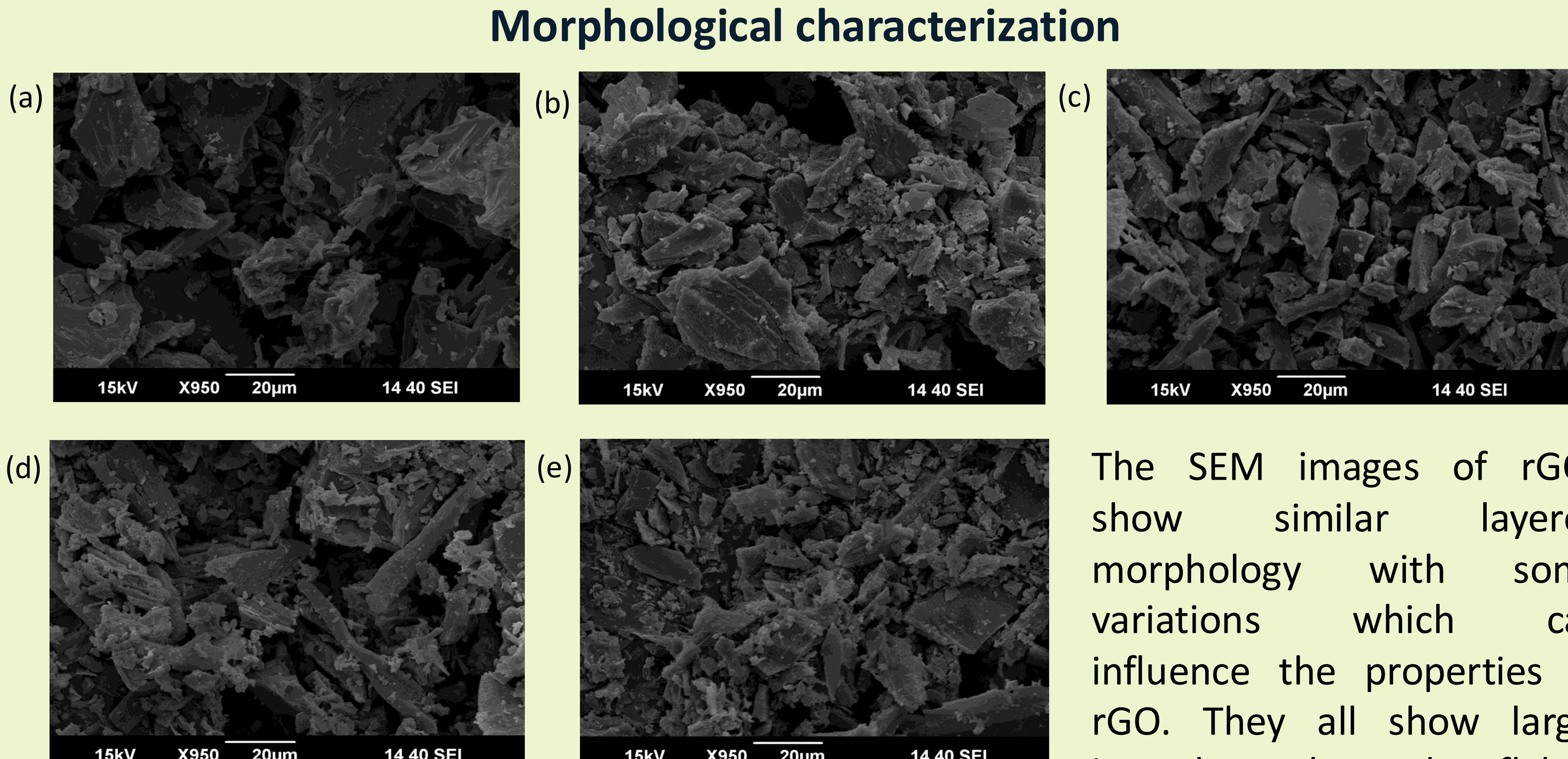


Figure 3. SEM images of rGO derived from a) pomegranate peels, b) banana peels, c) corn leaves, d) cotton wastes and e) mix of all

The SEM images of rGOs show similar layered morphology with some variations which can influence the properties of rGO. They all show large, irregular, layered flakes, indicating a highly exfoliated structure.

Surface characterization

Material	S_{BET} (m^2/g)	P_V (cm^3/g)	PSD (nm)
rGO_banana peels	78.79	0.012	72.28
rGO_pomegranate peels	34.86	0.046	57.36
rGO_cotton wastes	12.52	0.020	71.84
rGO_corn leaves	26.70	0.040	65.04
rGO_mix of all	18.00	0.030	75.02

rGO derived from banana peels provides the largest surface area making it ideal for adsorption and catalytic applications, while rGO from pomegranate peels represent the highest pore volume and the smallest pore size, which make it suitable for more selective applications.

4. CONCLUSIONS

In this investigation, rGOs derived from different biomasses were successfully produced, as shown by the characterizations analyzed above. The functional groups of all rGO samples are comparable, according to FTIR analysis, although peak intensity varies depending on the natural source, which may have an impact on the rGO's characteristics and uses. XRD variations in peak intensity suggest differences in crystallinity due to the biomass source, which also influences the material's properties.

ACKNOWLEDGEMENT

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