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Nanocomposites synthesized by decorating reduced graphene oxide with zinc oxide for electrochemical applications

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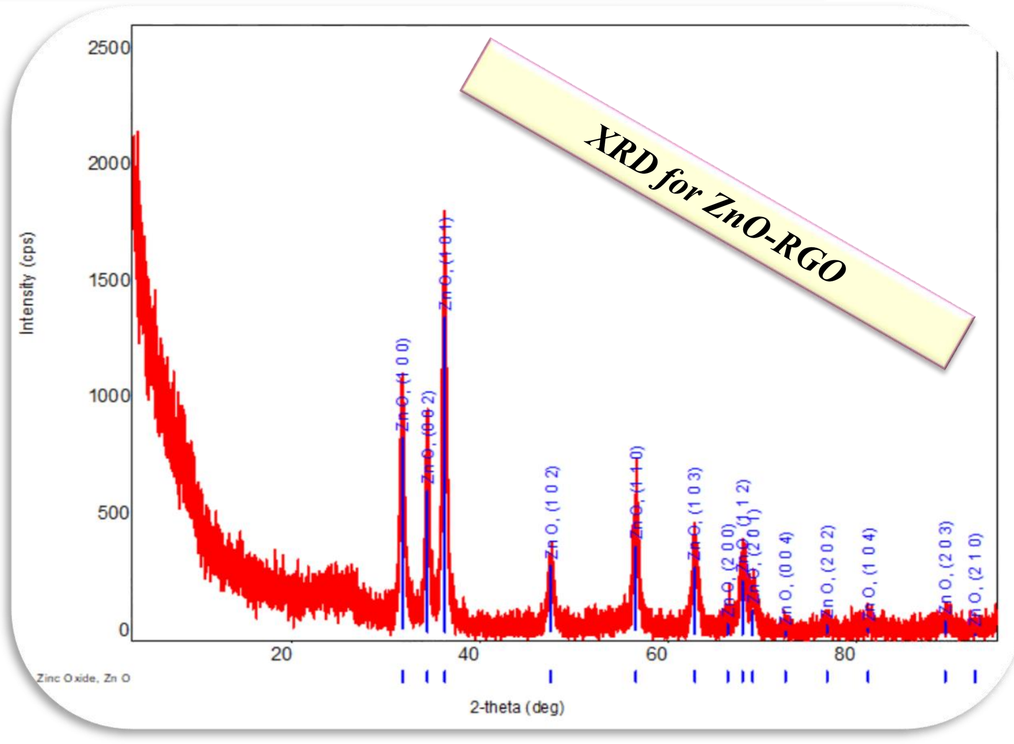
INTRODUCTION & AIM

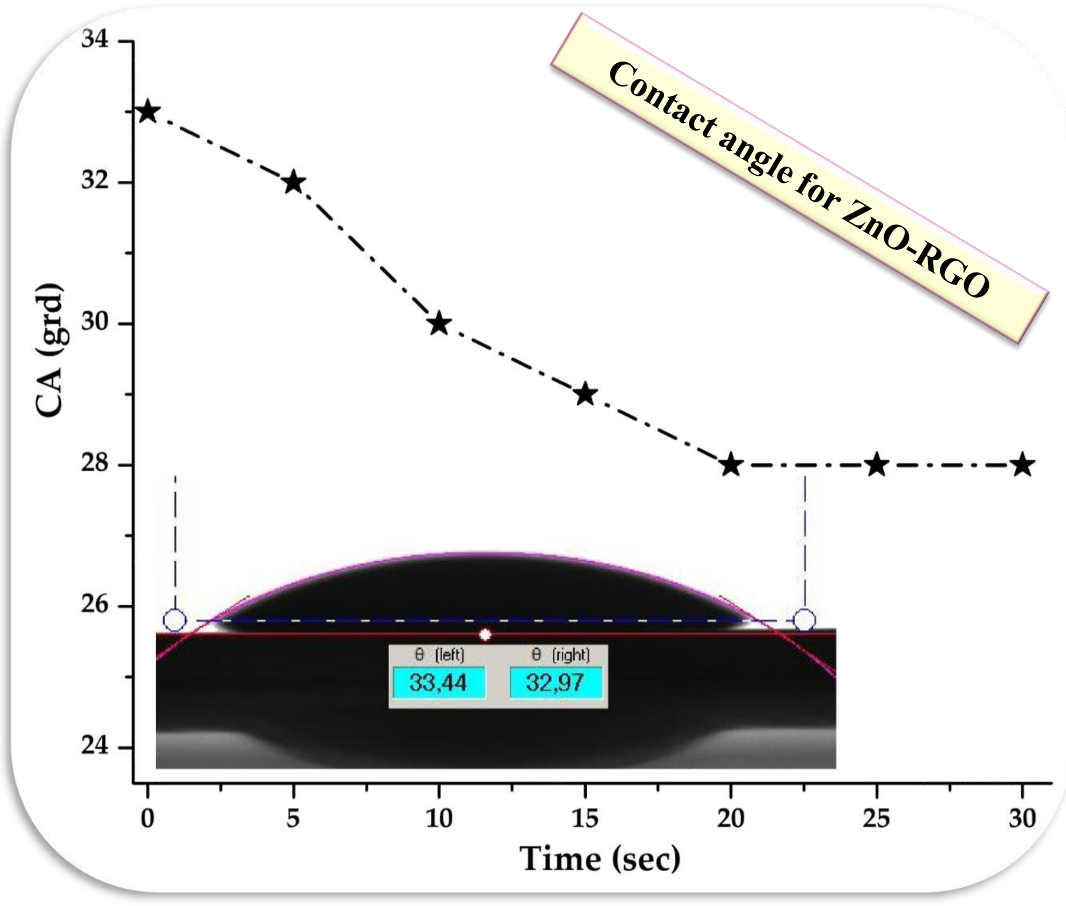
In 2004, the World Health Organization recommended the development of miniaturized diagnostic devices that are accessible, easy to use, selective, specific, economical, etc. By using nanotechnology to create sensors, the analytical electrochemistry field has made great progress in terms of expanding their application range, improving their reproducibility, decreasing their detection limits, and improving the ease of detection of the analyte of interest. The conductivity of nanocomposites is determined by the concentration, size, and dispersion of nanoparticles in the carbon matrix. The compatibility of carbon materials with different media is generally moderated by their strong interactions and high surface energy.

In this paper, we investigated the possibility of obtaining zinc oxide quantum dots (ZnO QDs) for the creation of nanocomposites based on transitional oxides and carbon materials made from reduced graphene oxide (RGO) for electrochemical applications. We used the precipitation process to generate ZnO QDs. The Hummer process was utilized to synthesize RGO. The ZnO-RGO nanocomposites were produced via an ex-situ technique. A range of analytical techniques were used to assess the shape, size, structural phase purity, functional groups, wettability, and other characteristics of the samples. Through the use of spectroscopic analysis, the structural aspects of the oxide, carbon material, and composite were investigated. The surface morphology, particle size, and distribution of nanoparticles in the carbon material were examined using a field-emission scanning electron microscope. Goniometric studies followed the percolation and wetting capacity studies of the nanocomposites. The application capacity of the ZnO-RGO nanocomposite was evaluated via cyclic voltammetry.

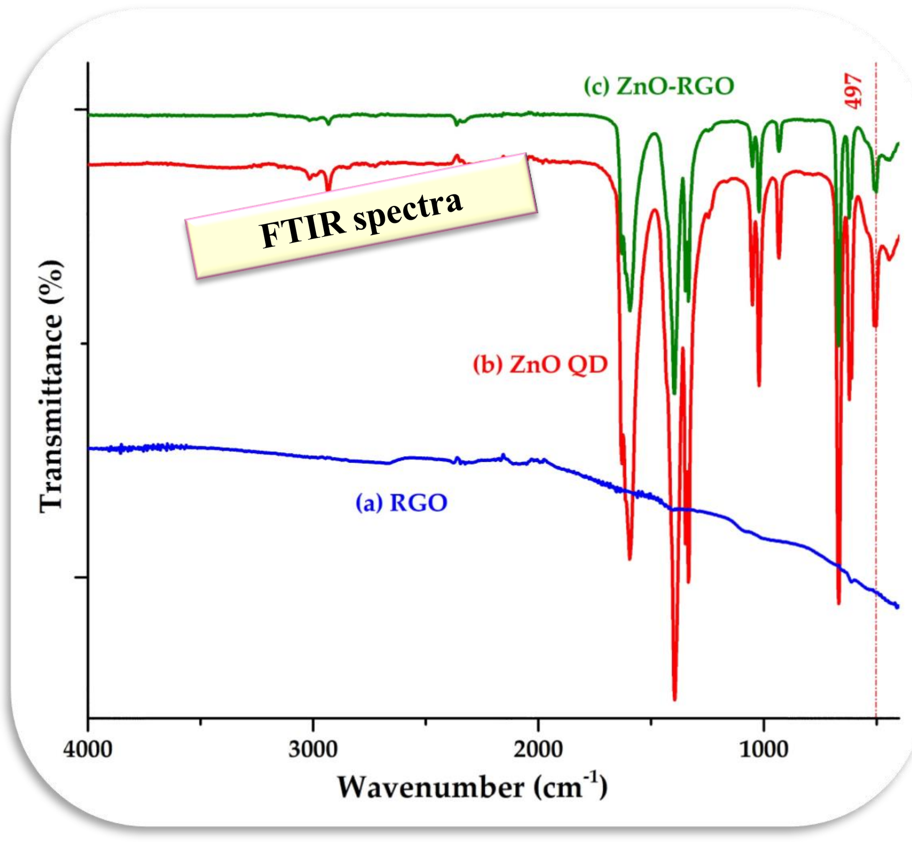
RESULTS



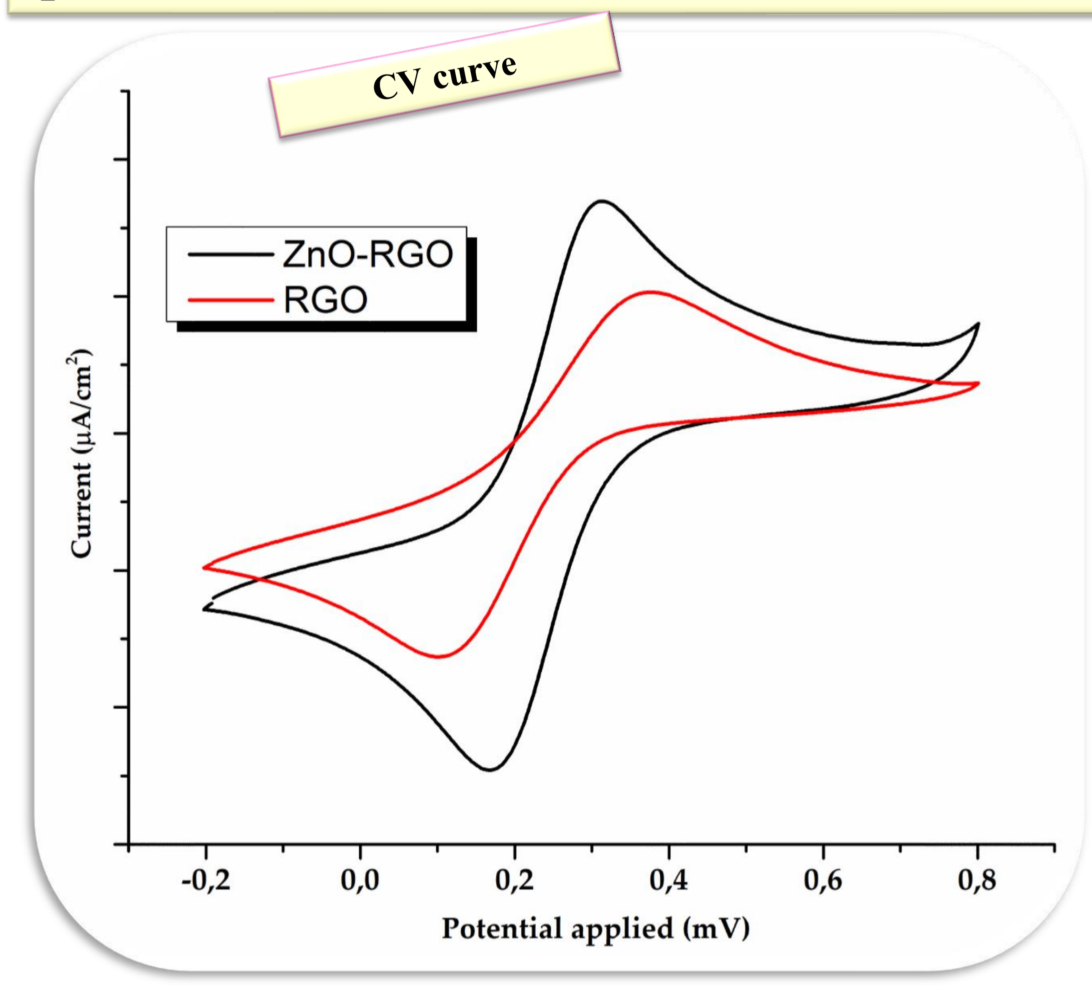
XRD structural analysis shows that the diffraction peaks can be attributed to ZnO wurtzite, with a slight shift of the peaks and a decrease in their intensity, indicating the insertion of oxide nanoparticles between the graphene sheets without changing the preferential orientation of the oxide.



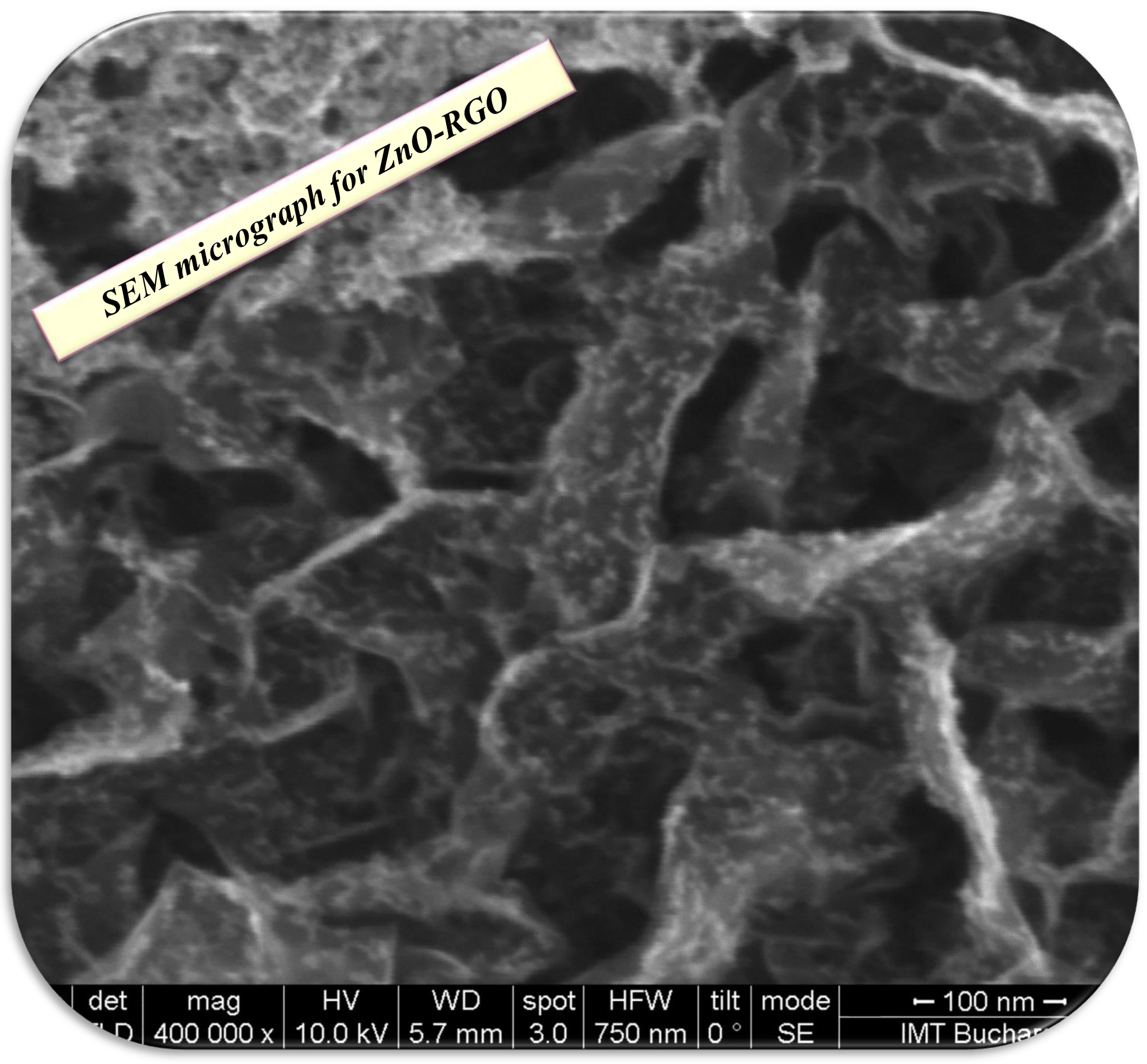
The contact angle is less than 90°, confirming that the obtained composites have hydrophilic surface properties.



RGO does not show any IR absorption bands. The composite spectrum contains characteristic peaks of ZnO QD. A band associated with Zn-O can be observed at around 497 cm^{-1}.



SEM images characteristic of ZnO-RGO composites show that ZnO nanostructured materials are distributed on the surface and embedded between the graphene sheets, showing good interaction between the components of the composites.



ACKNOWLEDGEMENTS / REFERENCES

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