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Hydrothermal synthesis of In_2O_3-GO nanocomposites for electrochemical applications

Vasilica ȚUCUREANU* , Cosmin Alexandru OBREJA, Marius STOIAN, Alina MATEI*

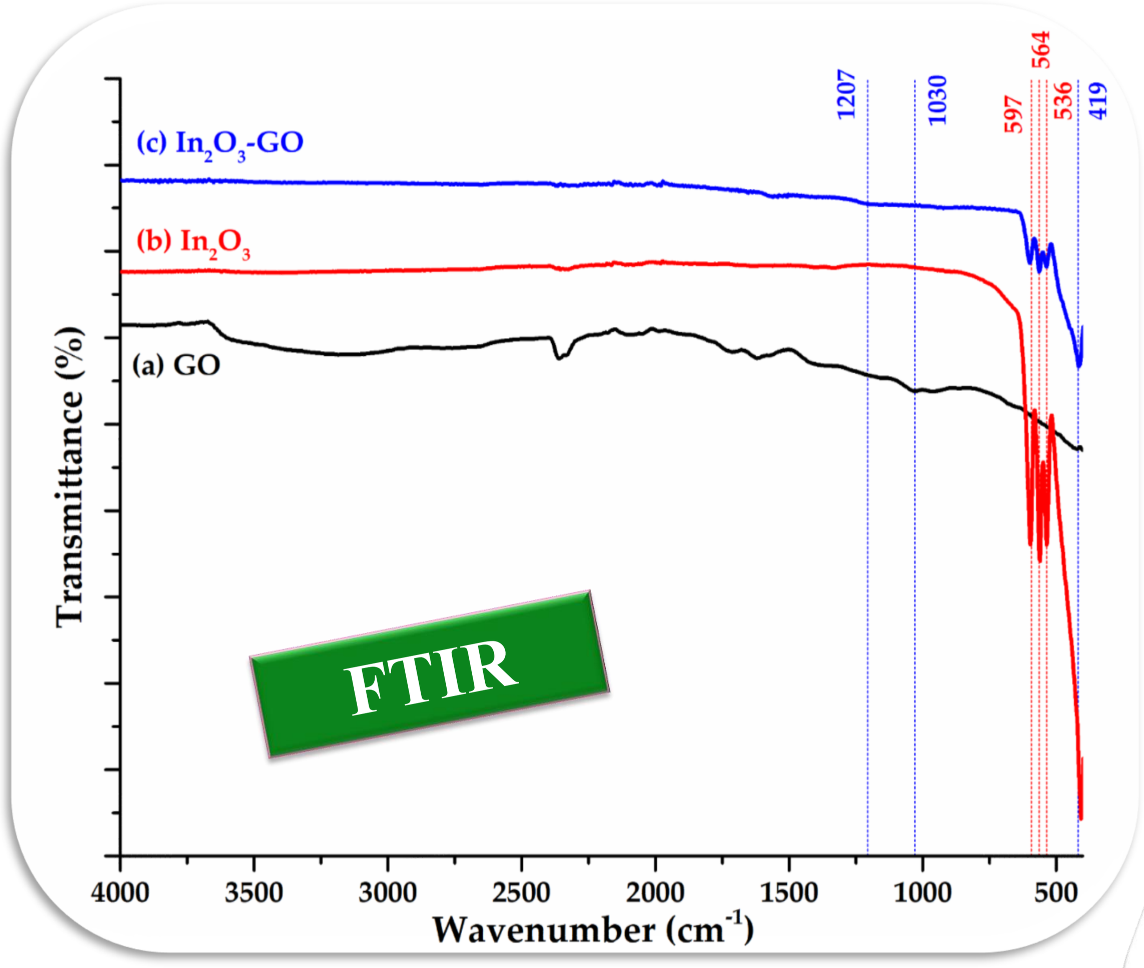
National Institute for Research and Development in Microtechnologies IMT-Bucharest

*Corresponding authors: vasilica.tucureanu@imt.ro; alina.matei@imt.ro

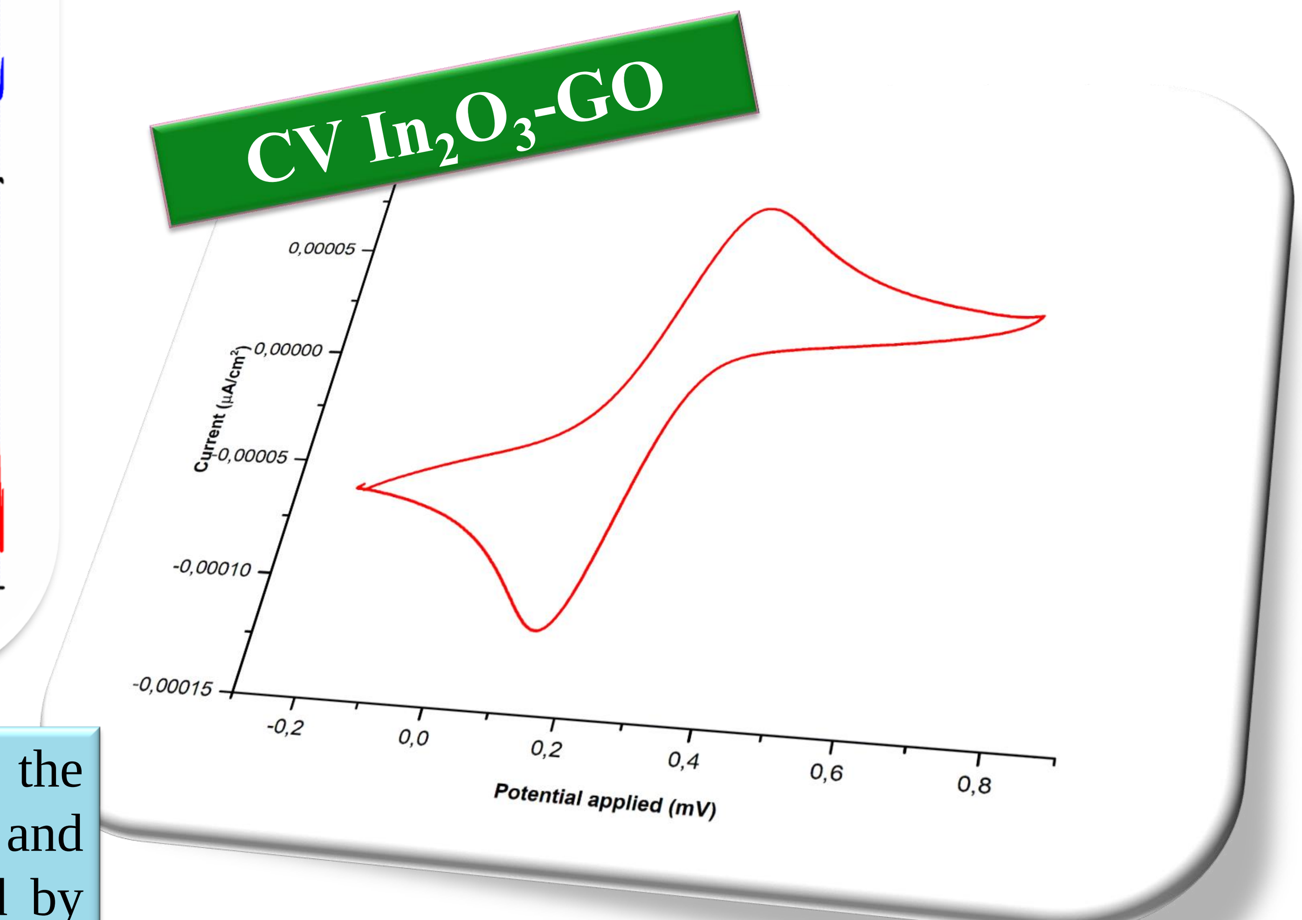
Abstract

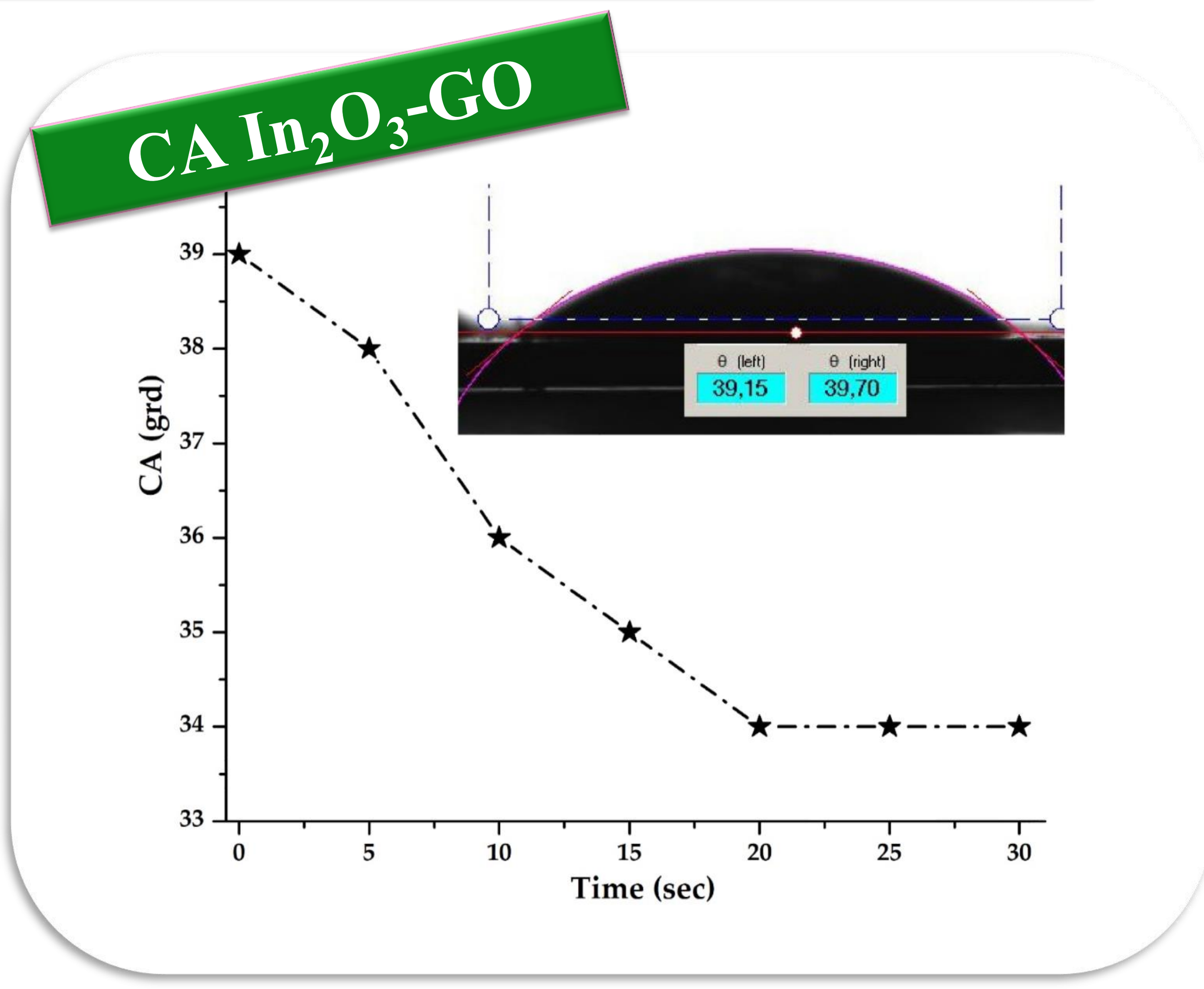
In recent decades, there has been an increasing interest in developing detection systems at the smallest scale and as easy to use as possible for a wide range of applications, including the food and environmental sectors, but especially for medical diagnostics. Advances in analytical electrochemistry research facilitate expanding the application range, improving repeatability, lowering detection limits, and simplifying the target analyte detection process by leveraging nanotechnology to produce sensors. In this work, we developed a synthesis method without additives for developing hybrid nanostructures obtained by embedding In_2O_3 nanoparticles in graphene oxide (GO) sheets for electrochemical applications. Using GO obtained by the Hummer method and indium nitrate as a precursor, In_2O_3-GO nanocomposites were obtained by an in-situ hydrothermal method. The samples' shape, size, structural phase purity, functional groups, and wetting capability were assessed using a range of analytical techniques. The structural characteristics of the oxide, carbon material, and composite were examined by spectroscopic analysis. The surface morphology, particle size, and distribution of In_2O_3 nanoparticles in the carbon material were examined using a field emission scanning electron microscope. The wetting and percolation threshold of the nanocomposite were observed through goniometric experiments. Cyclic voltammetry was used to evaluate the application potential of In_2O_3-GO nanocomposites.

Results



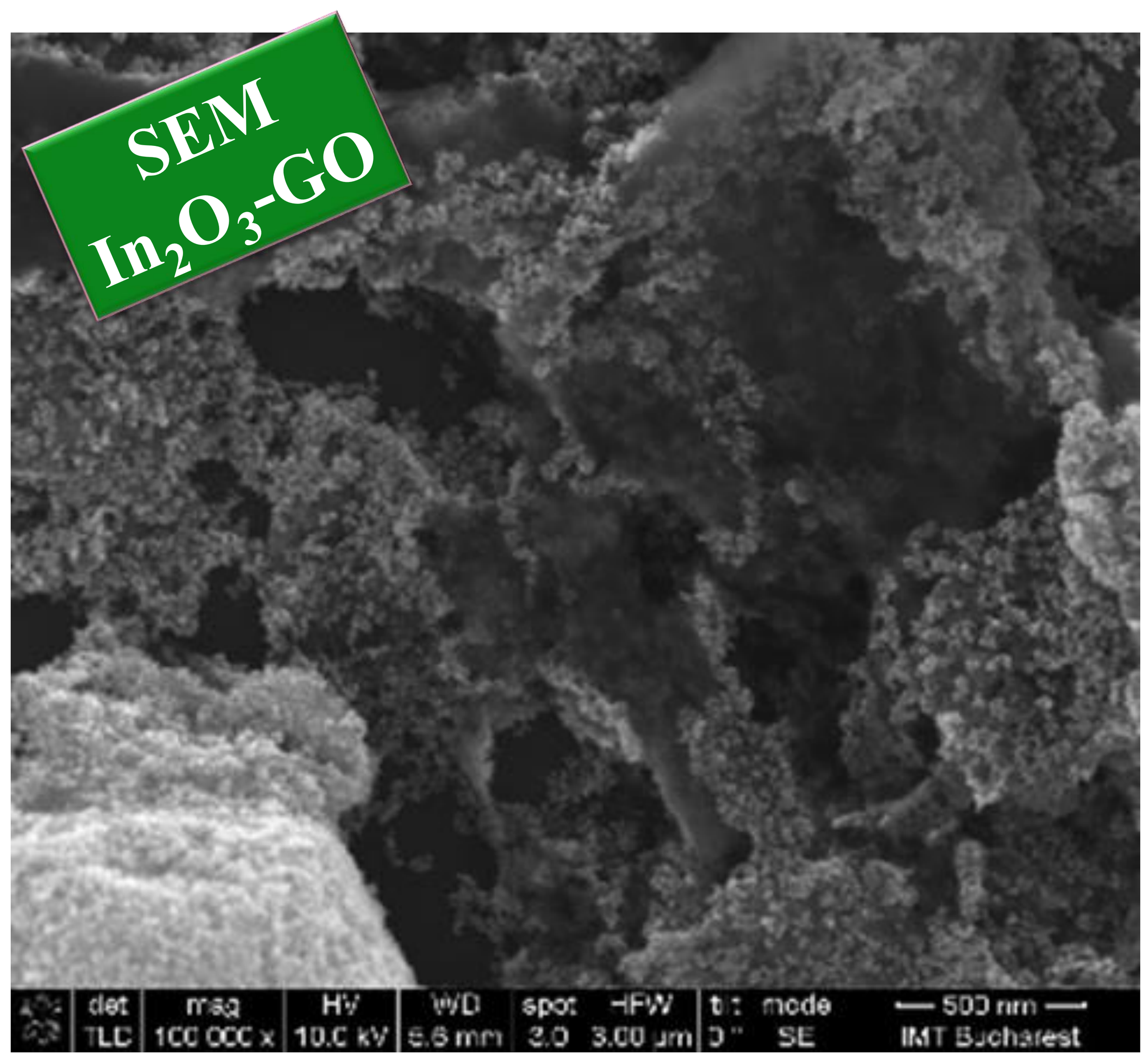
The spectra of the In_2O_3-GO samples confirm the formation of the composite through the OH and C=O groups in GO, an observation supported by the disappearance from the composites spectra of both the broadband in the range 4000-3000 cm^{-1} and 1704 cm^{-1}. The spectra of the composites are mainly defined by high-intensity bands related to the vibration mode of M-O (below 600 cm^{-1}) and GO (1556, 1206 and 1030 cm^{-1}, due to the vibration mode of the C-O bonds).

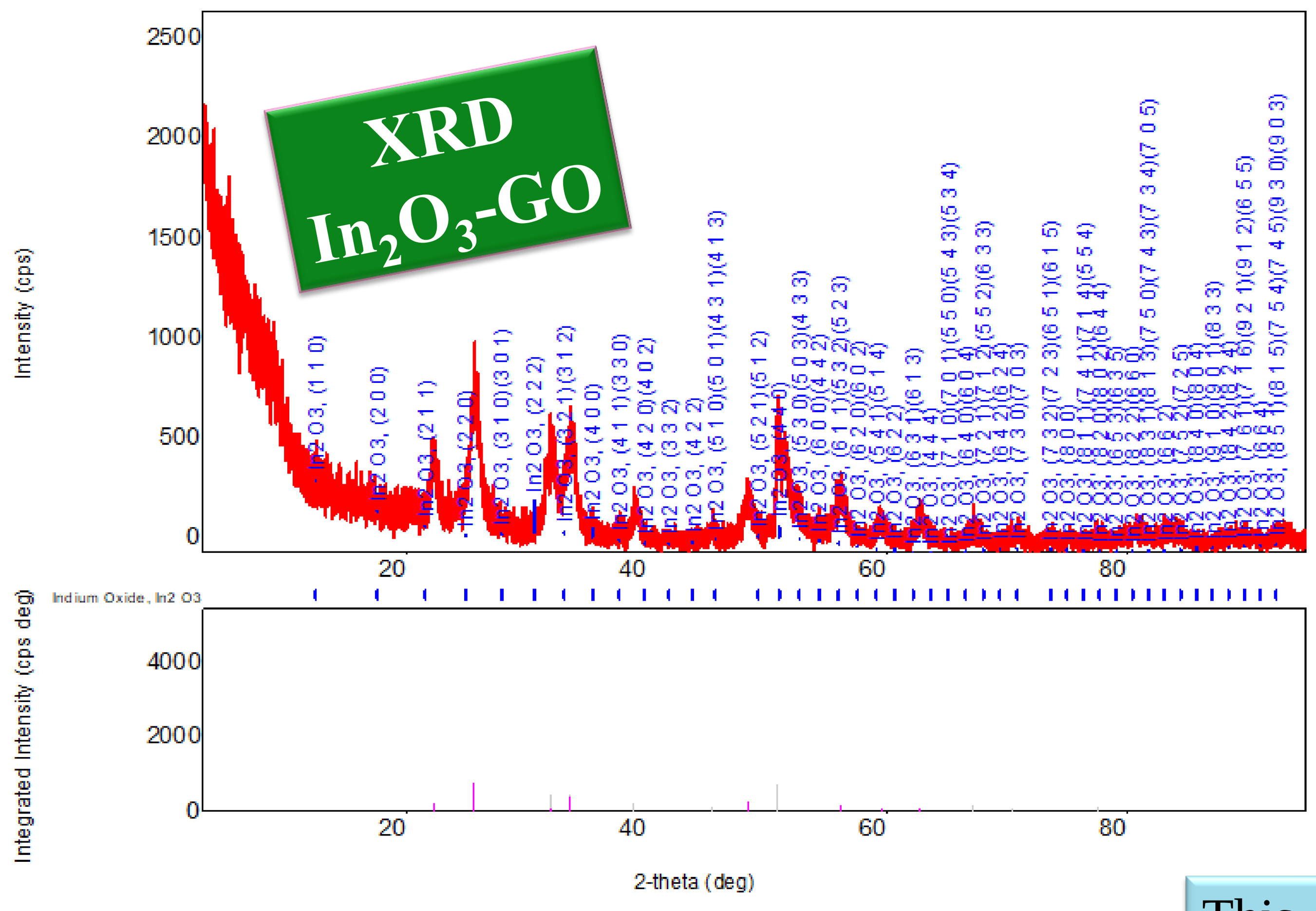




The contact angle is less than 40°, confirming that the obtained composites have hydrophilic surface properties.

SEM images characteristic of the In_2O_3-GO composites show that In_2O_3 nanostructured materials are embedded between the graphene sheets, showing good interaction between components of the composites.





XRD structural analysis shows that the diffraction peaks can be attributed to the cubic crystalline structure of indium oxide, 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.

Acknowledgements / References

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