IOCN 2025 Conference

The 5th International Online Conference on Nanomaterials

22–24 September 2025 | Online

MDPI

New Multifunctional Natural Biomaterials Based on ZnO Nanoparticles and Polysaccharide Gums Obtained by Green Synthesis

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INTRODUCTION & AIM

Eco-friendly and cost-effective ZnO nanoparticles were synthesized via a green approach employing three biologically derived polysaccharide gums: acacia, guar, and xanthan as stabilizing and reducing agent.

The aim is to produce biocompatible nanoparticles with improved functional properties for biomedical applications.

METHOD

The synthesis was performed under mild conditions, using materials of natural origin. The successful formation of ZnO nanoparticles using these gums was confirmed through FTIR, XRD, thermal analysis, SEM, Raman spectroscopy, and photoluminescence studies.

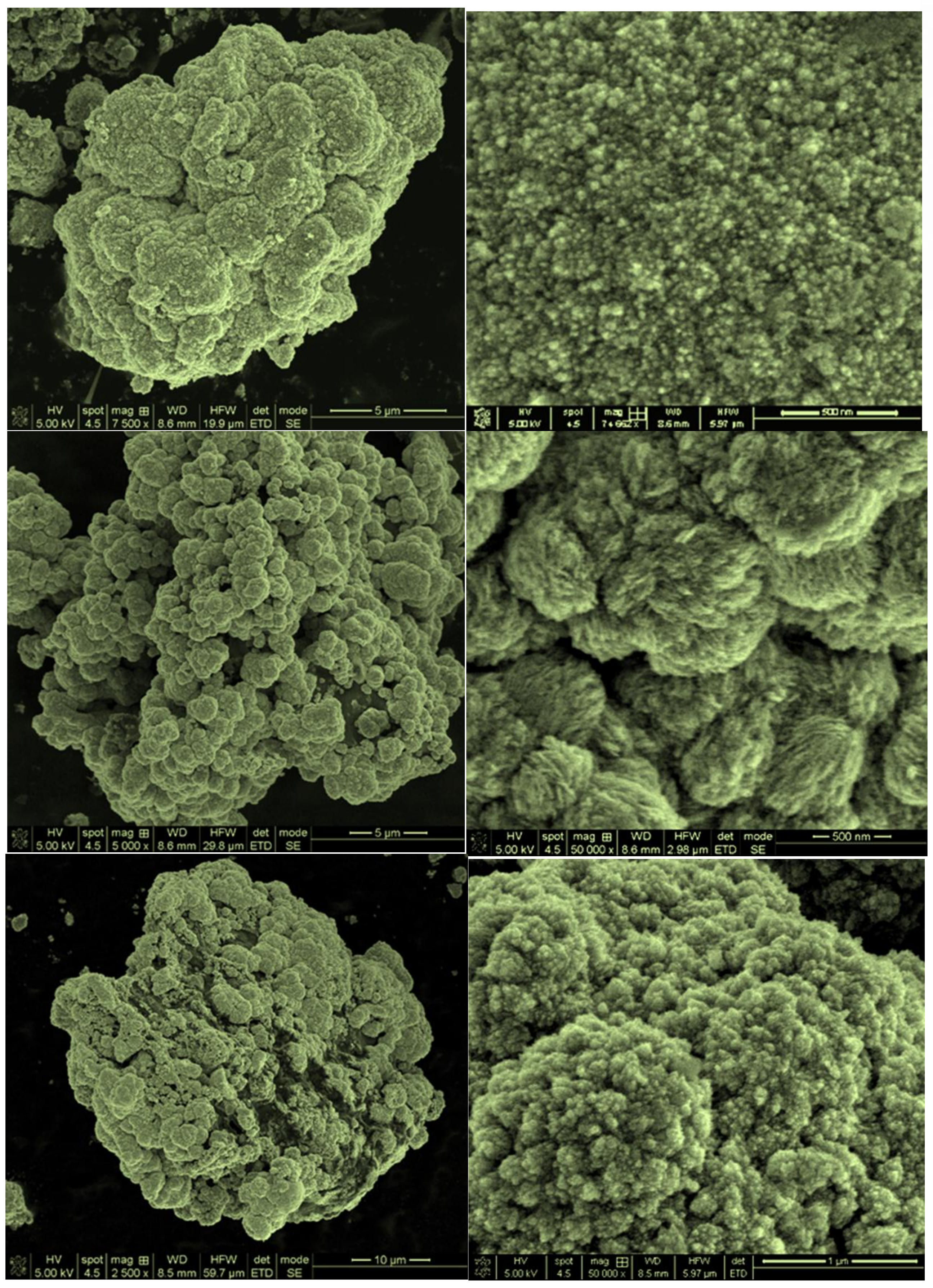

Fig. 6. SEM micrographs at different magnification: (a-b) ZnO-A; (c-d) ZnO-G and (e-f) ZnO-X.

RESULTS & DISCUSSION

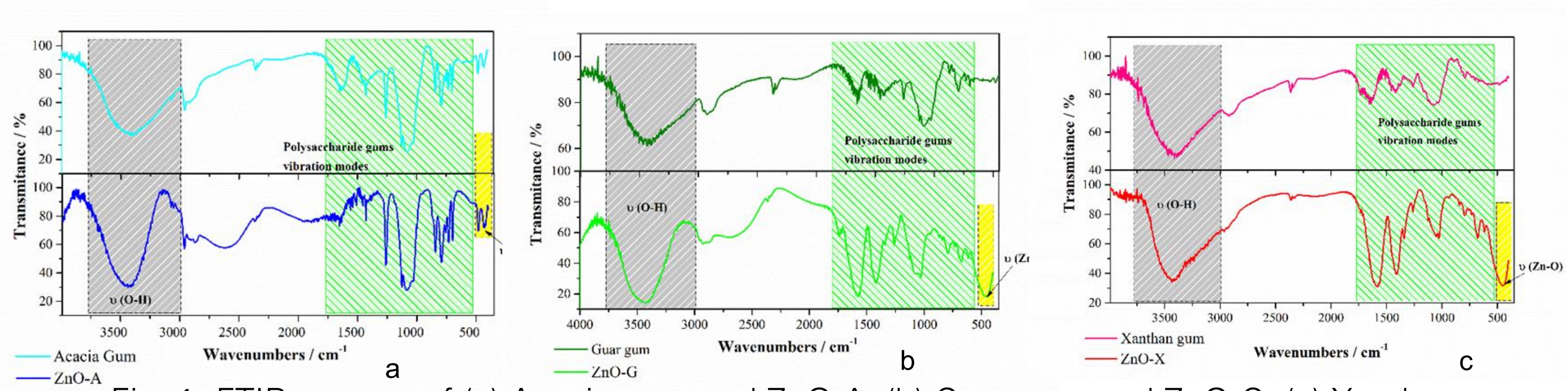

Fig. 1. FTIR spectra of (a) Acacia gum and ZnO-A; (b) Guar gum and ZnO-G; (c) Xanthan gum and ZnO-X.

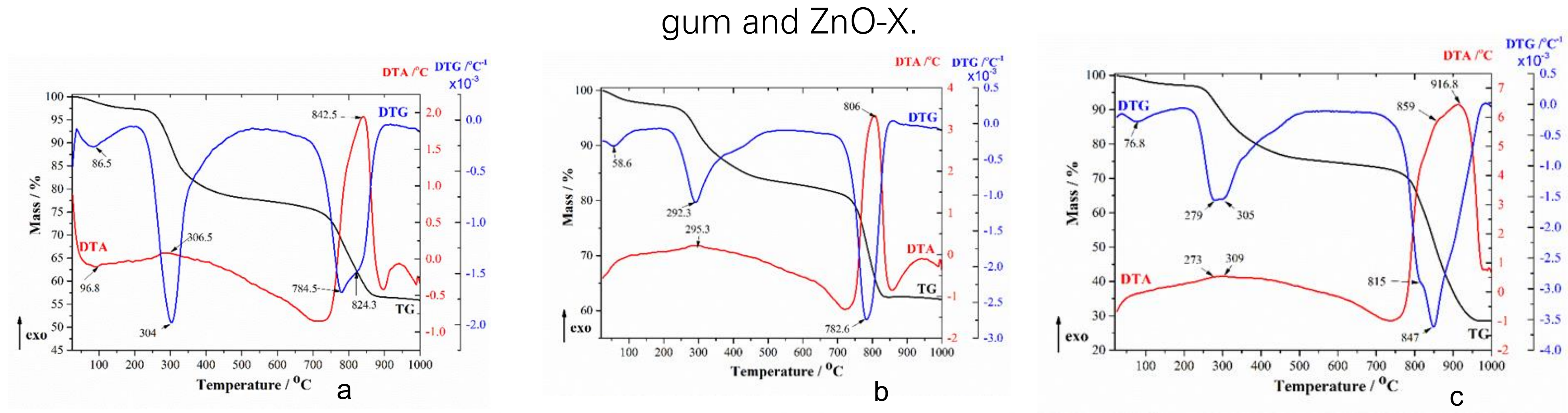

Fig. 2. Thermal curves of (a) ZnO-A, (b) ZnO-G and (c) ZnO-X nanoparticles (nitrogen atmosphere, heating rate of 10°C/min)

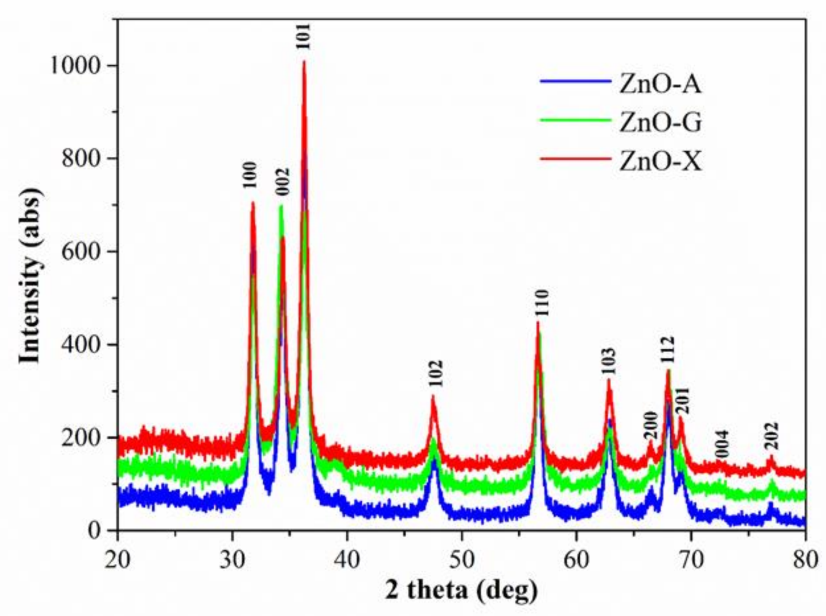

Fig. 3. The X-ray diffractograms of ZnO-A, ZnO-G and ZnO-X samples

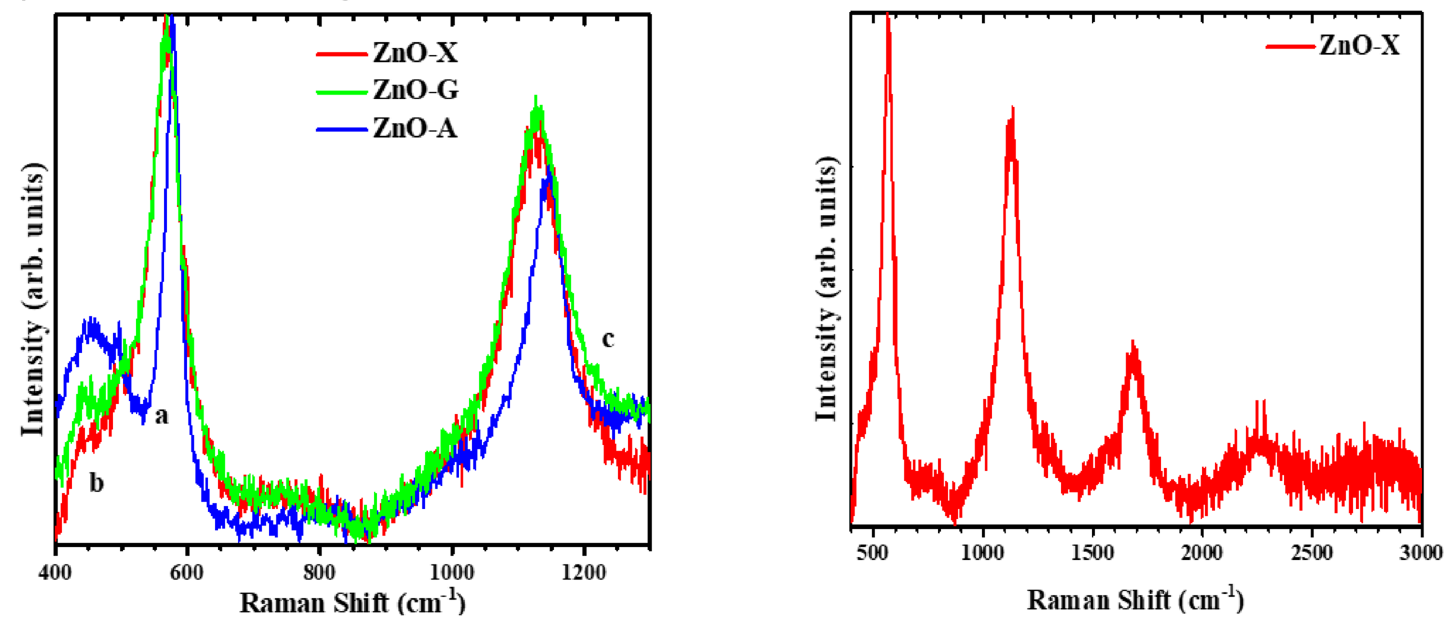

Fig. 4. Resonant Raman spectra of (a) ZnO-A (b) ZnO-G, and (c) ZnO-X and (right) extended spectral region of the ZnO-X spectrum.

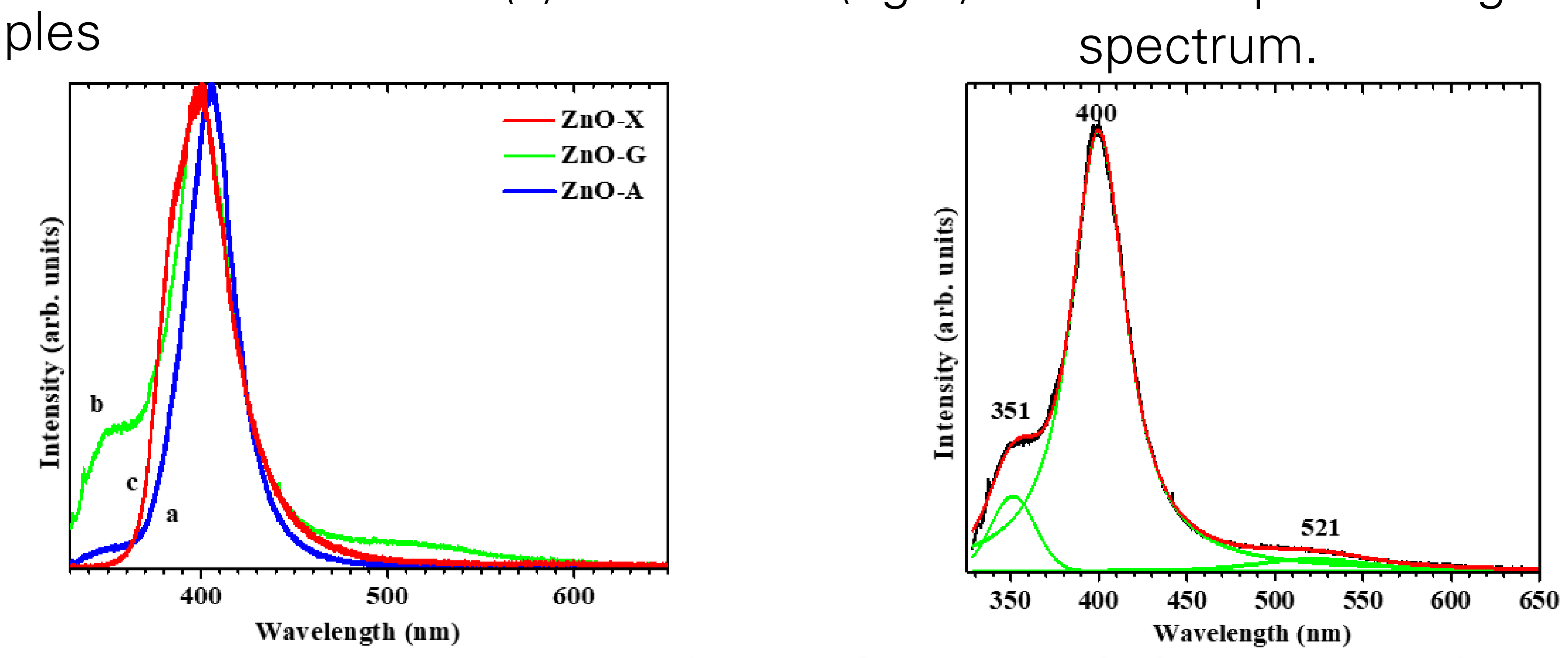

Fig. 5. Photoluminescence spectra of (a) ZnO-A (b) ZnO-G, and (c) ZnO-X and (right) deconvolution of the ZnO-G spectrum showing the broad band in the visible region and two bands in the UV region.

ZnO-A, G, and X nanoparticles (~14 nm) exhibit IR and XRD profiles consistent with pure hexagonal wurtzite ZnO (JCPDS 36-1451), confirming high purity and crystallinity. Thermal analysis reveals three steps: dehydration, surface group removal, and structural reorganization. SEM shows cauliflower-like morphologies. Raman spectra display characteristic LO phonons, while PL indicates a defect-free crystal lattice.

CONCLUSION

This study demonstrates that polysaccharides employed as chelating agents provide an effective strategy for the biosynthesis of ZnO NPs, enabling controlled morphology and highlighting their potential for biomedical applications.

Acknowledgments: The support of the Romanian Government that allowed for the acquisition of the research infrastructure under POSCCE O 2.2.1 project INFRANANOCHEM No. 19/01.03.2009 is gratefully acknowledged.
Funding: This research was funded by the Romanian National Authority for Scientific Research and Innovation.