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Binary transition metal oxide nanostructures and their potential biosensor applications

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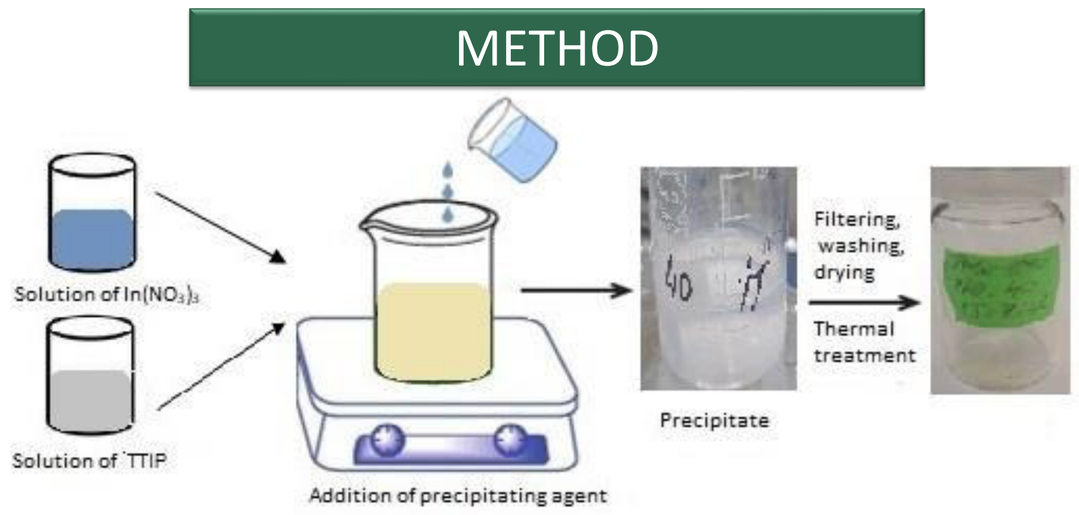
INTRODUCTION & AIM

Binary metal oxide nanostructures have received much attention as potential materials in biosensor development, due to their chemical and structural stability, good conductivity, catalytic activity, and high reversible capacity. By combining metal oxides (e.g. TiO_2, In_2O_3, ZnO, and CuO), various versatile materials are obtained, capable of creating sensitive and selective platforms for detecting certain biological or chemical analytes. Among them, In_2O_3-TiO_2 is considered a promising structure for speeding up electron transfer, preventing the recombination of electron-hole pairs, and has superior photocatalytic activity, and remarkable photonic activity under visible light illumination.

In this study, the In_2O_3-TiO_2 nanostructures were synthesized by the cation precipitation method, varying the conditions of the synthesis process, and thermal treatment at the optimum temperature of 550°C.

METHOD



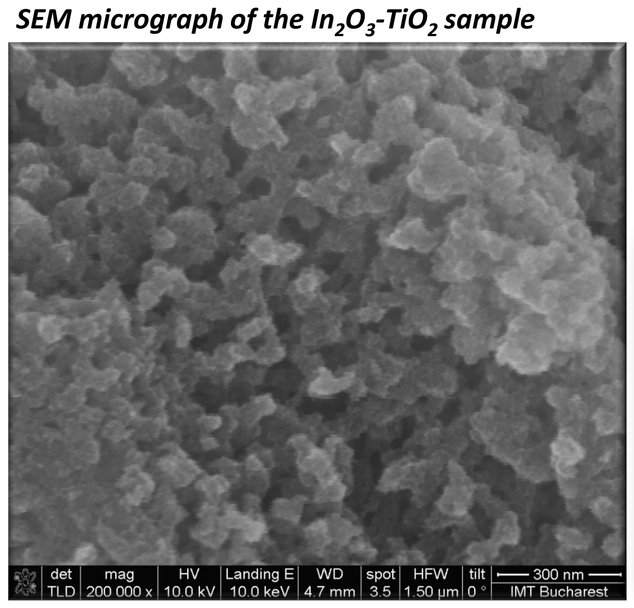
Steps in the precipitation process for the obtaining of In_2O_3-TiO_2 powder

CONCLUSION

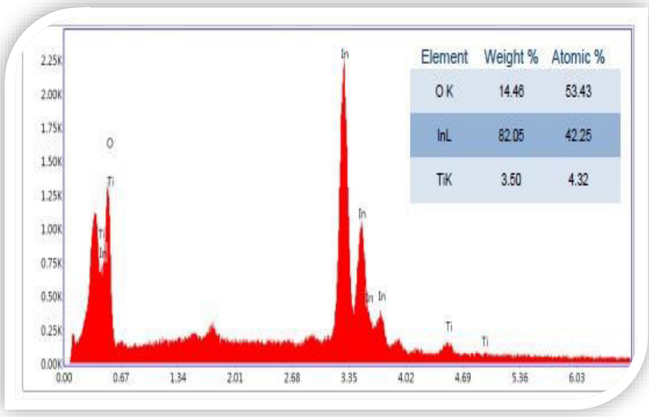
- *Different analytical methods were used to evaluate the physico-chemical characterization of the In_2O_3-TiO_2 samples.*
- SEM microscopy allowed morphological characterization and revealed agglomerated formations of almost spherical particles with small sizes.
- EDX provides information at the atomic level, with characteristic peaks of titanium, indium, and oxygen, confirming the purity of the nanoparticles.
- XRD analysis confirmed that the synthesized particles belong to the tetragonal anatase phase TiO_2 (Card No. 00-001-0562) and standard In_2O_3 patterns (Card No. 00-006-0416). The average crystallite size of the In_2O_3-TiO_2 NPs was 21.65 nm.
- Structural characterization was conducted using FTIR spectroscopy, highlighting bands assigned to In-O and Ti-O bonds.
- The applicability of the In_2O_3-TiO_2 nanostructures is supported by their hydrophilic behavior and the possibility of percolation, which are properties determined by the contact angle with values varying between 22-14°.

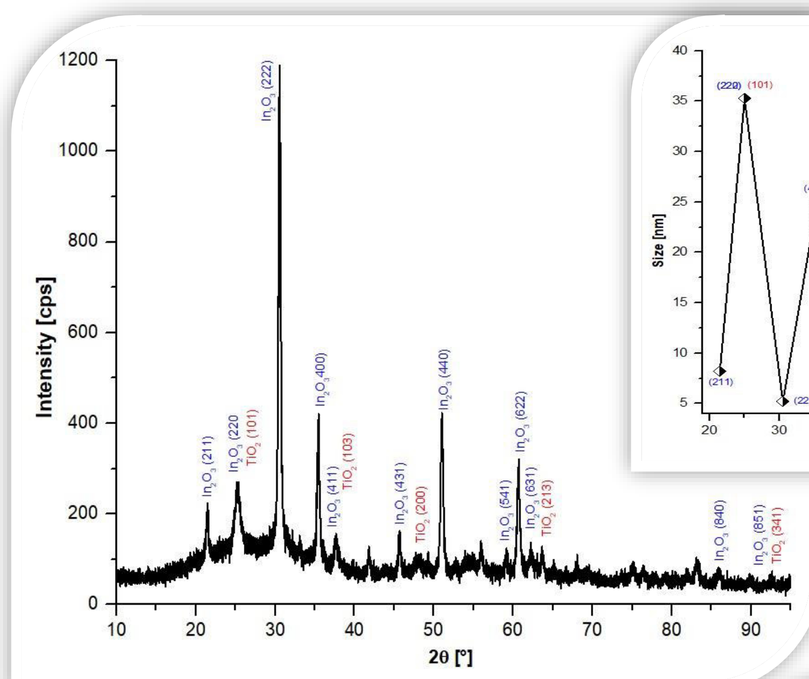
RESULTS & DISCUSSION

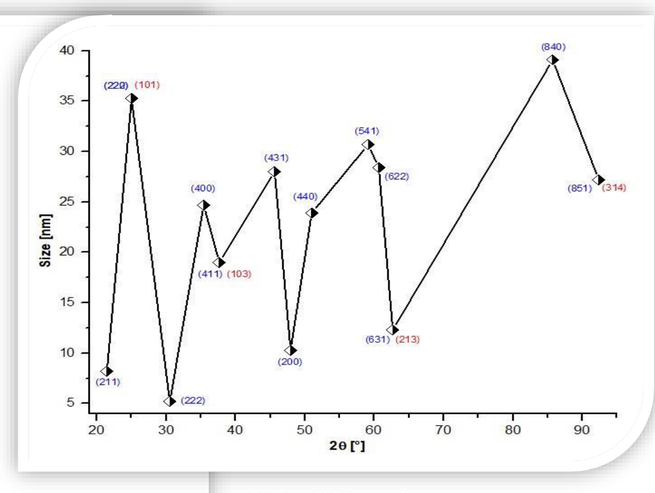
SEM micrograph of the In_2O_3-TiO_2 sample



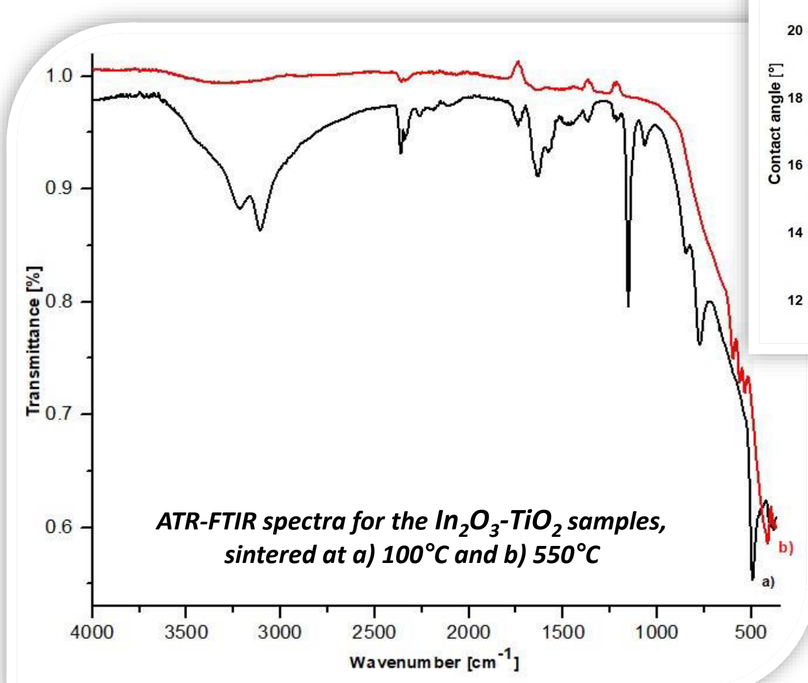
EDX spectrum of the In_2O_3-TiO_2 sample



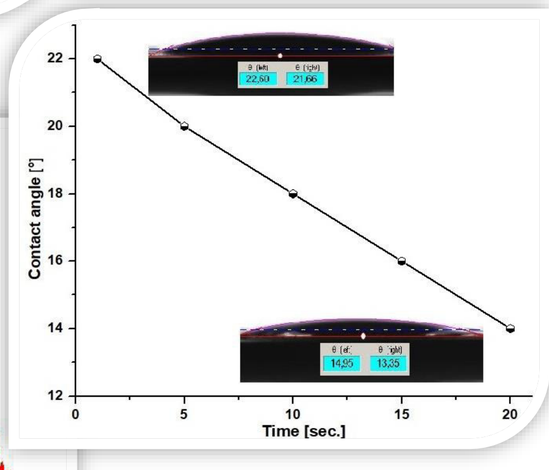




XRD diffraction patterns and size of the In_2O_3-TiO_2 sample



ATR-FTIR spectra for the In_2O_3-TiO_2 samples, sintered at a) 100°C and b) 550°C



The variation of contact angle depending on time at the contact of the water droplet with the surface of the In_2O_3-TiO_2 sample

REFERENCES / ACKNOWLEDGMENTS

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