

Modified composite Fe_3O_4/ZnO nanoparticles for environmental remediation

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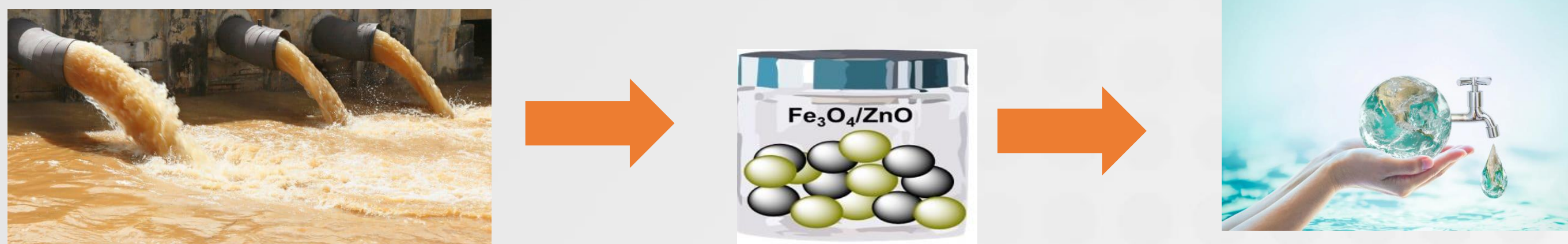
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Introduction

Environmental and energy resource development and preservation may be achieved through the utilization of nanomaterials in water treatment technology (Qu et al.,2013). Metal oxides with synergistic properties of adsorption and photocatalysis are promising nanomaterials for environmental water and wastewater remediation. Heavy metal contamination in water is an alarming concern that requires intervention through advanced hybrid nanomaterial fabrication. Fe_3O_4/ZnO NPs can be tailored through modification to optimize active adsorption sites, such as corners, edges, vacancies, and high-energy crystalline facets. Therefore, modified Fe_3O_4/ZnO NPs can be a hybrid solution for the removal of toxic metals, bacteria and emerging contaminants from water, respectively.



Methodology

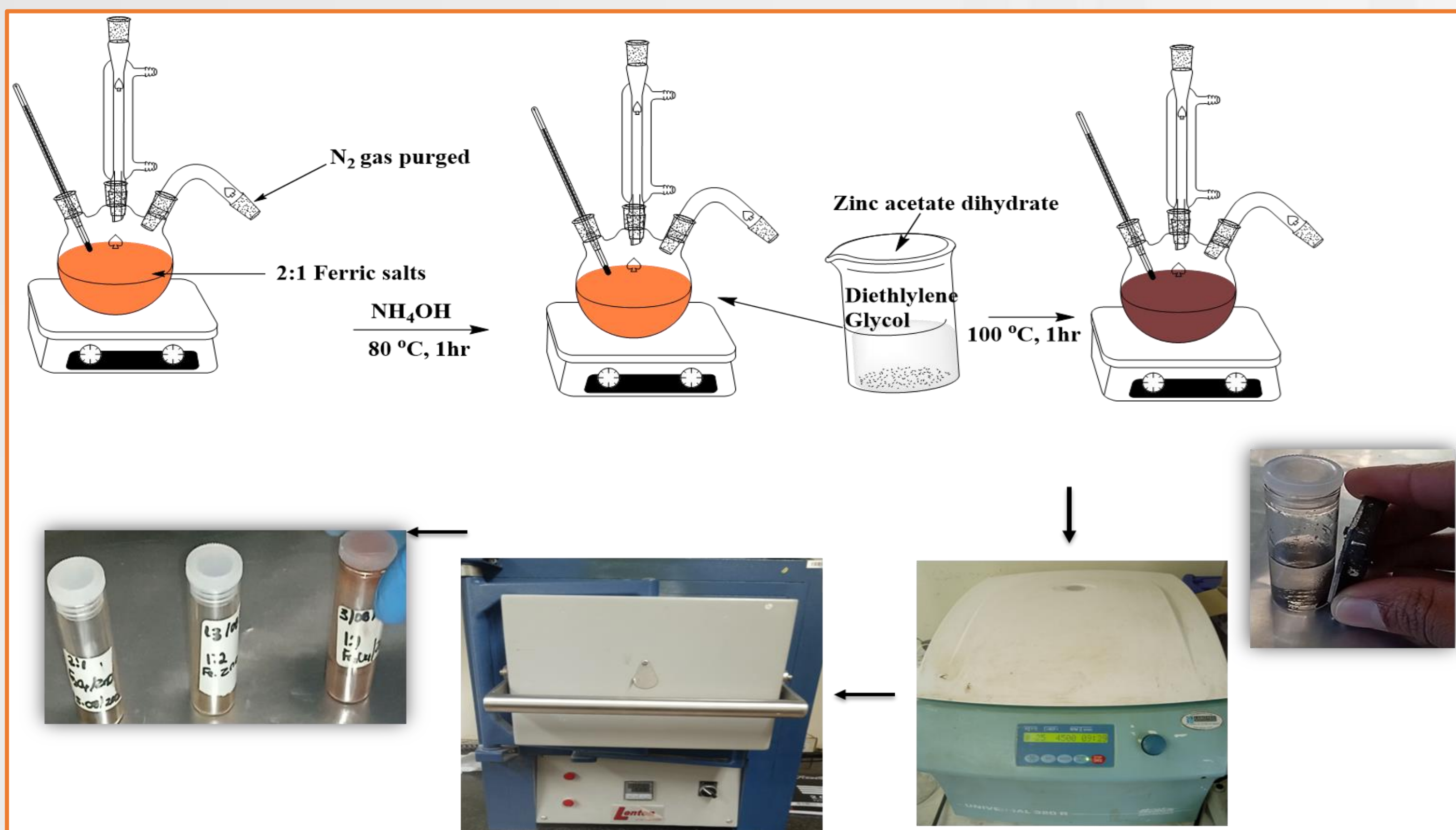


Figure 1: Schematic images of modified Fe_3O_4/ZnO synthesis procedure.

Results & Discussion

TEM and EDX images

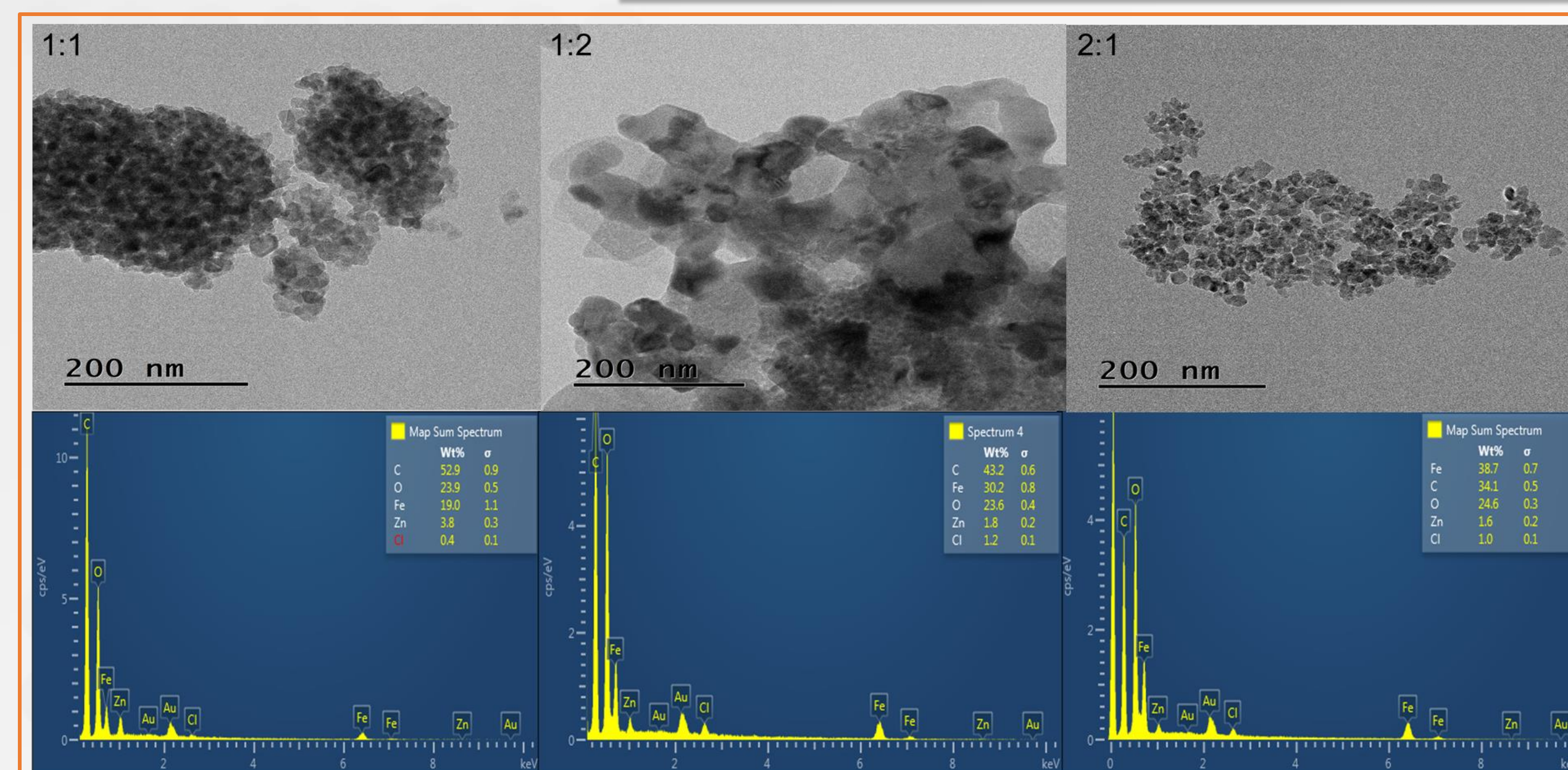


Figure 2: TEM images of Fe_3O_4/ZnO composite ratios

The morphology of the NPs showed that the NPs were a combination of spherical and cubic shaped NPs.

FTIR & XRD analysis

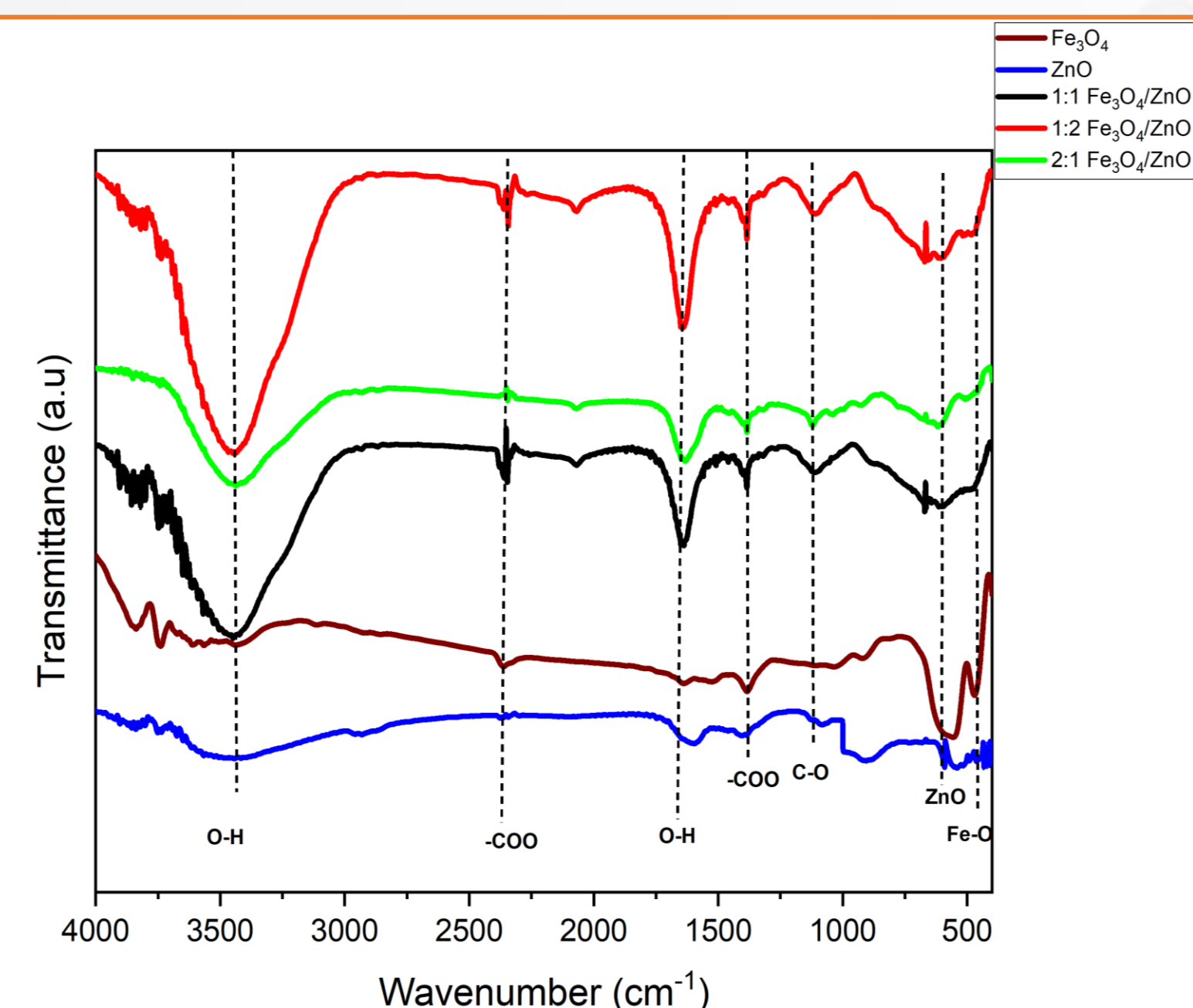


Figure 3 : FTIR spectra of Fe_3O_4 , ZnO and the different composite ratios of Fe_3O_4/ZnO (1:1,1:2 & 2:1)

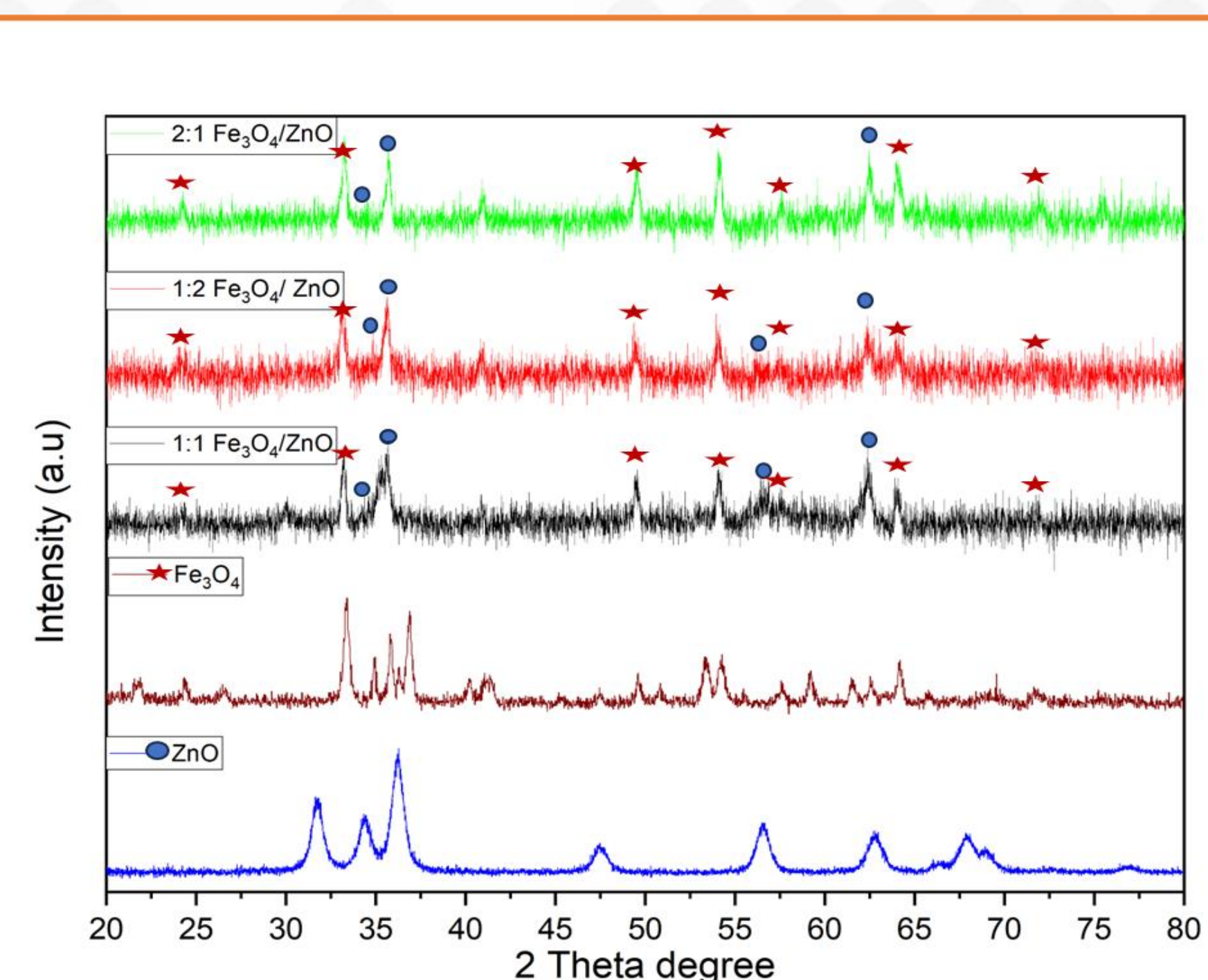


Figure 4: XRD analysis for Fe_3O_4/ZnO composite ratios

Optical properties

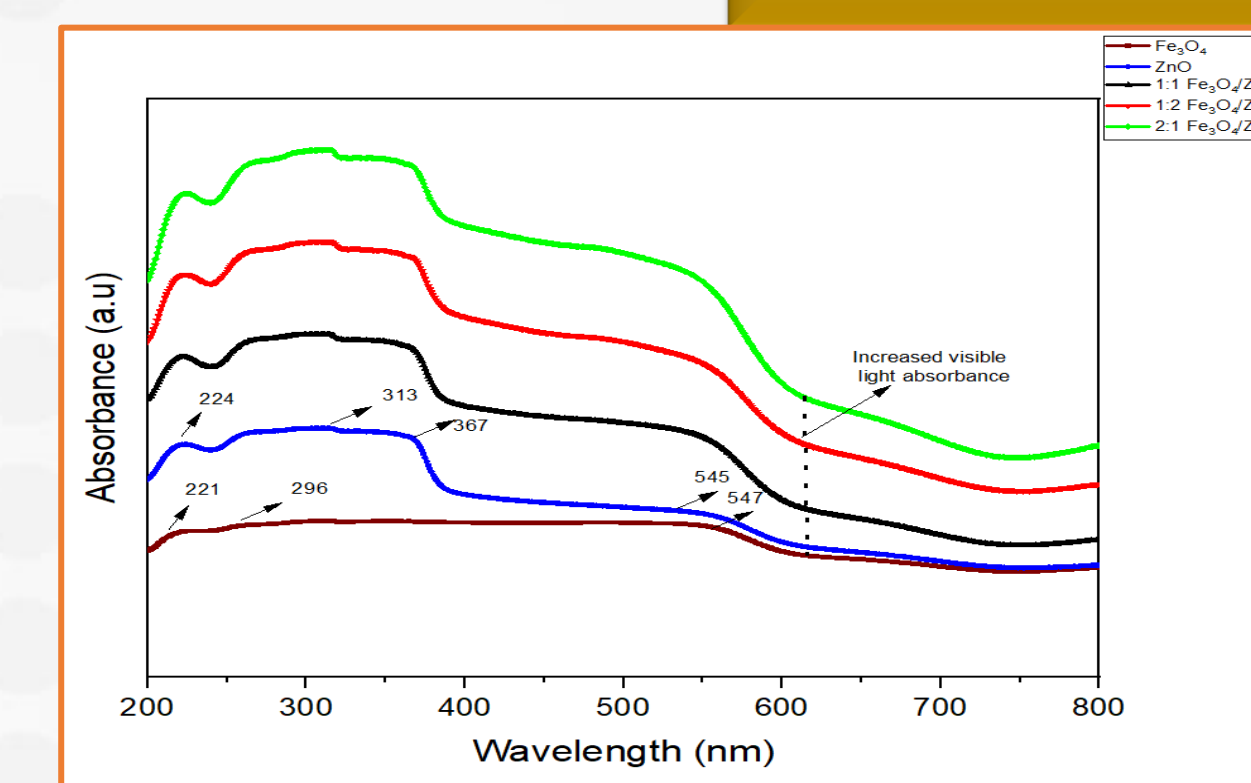


Figure 5: UV-vis spectra of Fe_3O_4 , ZnO and the different composite ratios of Fe_3O_4/ZnO

Table 1: Tauc plot band gap energies

Tauc plot of the nanoparticles and composite NPs	Band Gap Energy (eV)
Fe_3O_4	1.76
ZnO	2.73
1:1 Fe_3O_4/ZnO	2.07
1:2 Fe_3O_4/ZnO	2.05
2:1 Fe_3O_4/ZnO	2.06

BET analysis

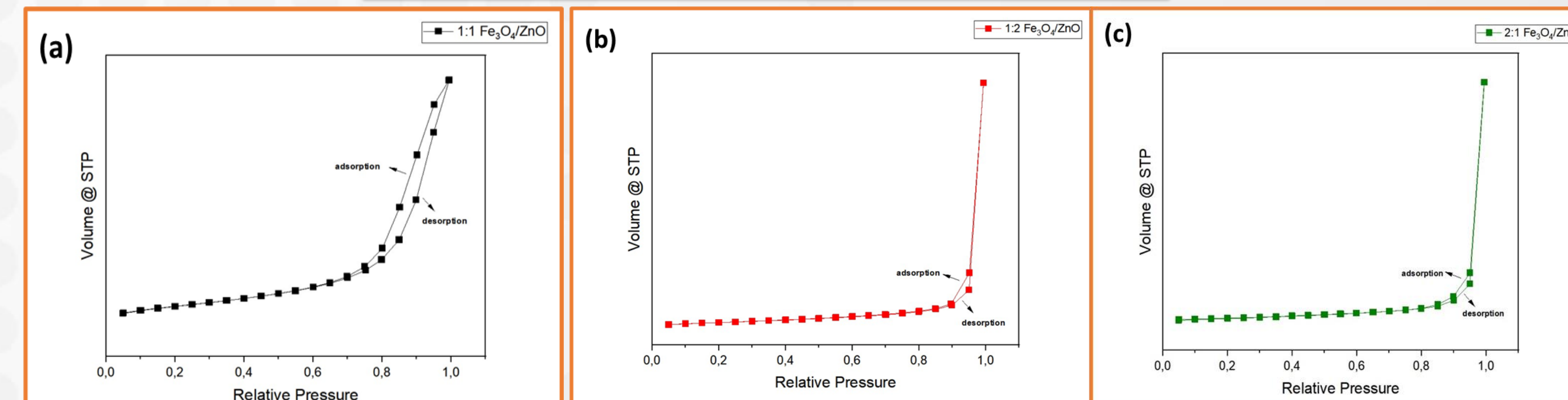


Figure 6: Adsorption and desorption of the different composite ratios of Fe_3O_4/ZnO (1:1,1:2 & 2:1)

Table 2: Surface The surface area, pore volume and mean pore diameter of Fe_3O_4/ZnO

Ratio of Fe_3O_4/ZnO	BET surface area (m^2/g)	Pore volume (cc/g)	Mean pore diameter (nm)
1:1	94.360	0.360	12.454
1:2	12.595	0.221	1.7047
2:1	14.537	0.276	1.7067

Lessons Acquired & Future perspectives

- SEM showed that the NPs was a composite of spherical and cubic shape
- EDX, FTIR, and XRD confirmed the elemental composition, functional groups, and crystal indexes confirmed well defined peaks corresponding to Fe_3O_4 and ZnO peaks.
- The large band gap energies of the composite ratios and surface area illustrate that the NPS can further be applied for water treatment applications

Acknowledgements

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References

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