IOCM 2025 Conference
The 4th International Online Conference on Materials
3–6 November 2025 | Online
MDPI

Eco-friendly Anticorrosive Epoxy-Based Coatings Reinforced With GO-coated Chitosan nanoparticles

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INTRODUCTION

Problem Statement:

- Corrosion causes major structural and environmental damage in industries.
- Conventional coatings lack long term durability and corrosion resistance.
- There is a need of eco-friendly, high performance, multifunctional coatings.

Proposed Solution:

- Development of Anti-corrosive coatings based on epoxy resin reinforced with GO-Chitosan nanoparticles.
- GO being the barrier enhancer, lowers the porosity and penetration of particles.
- Chitosan as a biocompatible material enhances the adhesion and film forming ability.
- The proposed nanocomposite coating enhances the resistance to corrosion, along with the mechanical and coating stability.

METHOD

GO Synthesis & Coating Development Strategy

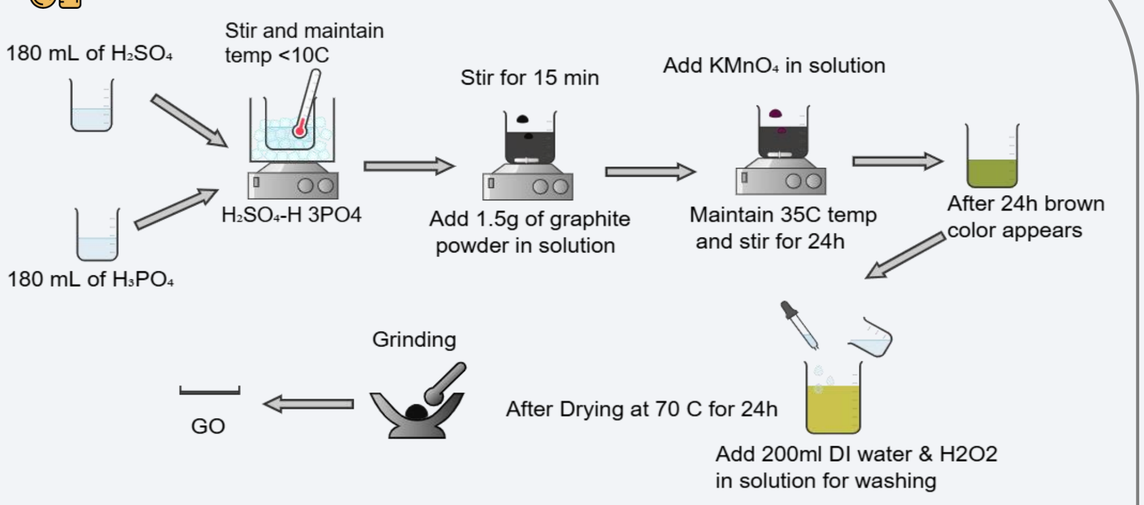


Figure 1 Preparation of Graphene Oxide via Hummer's Method.

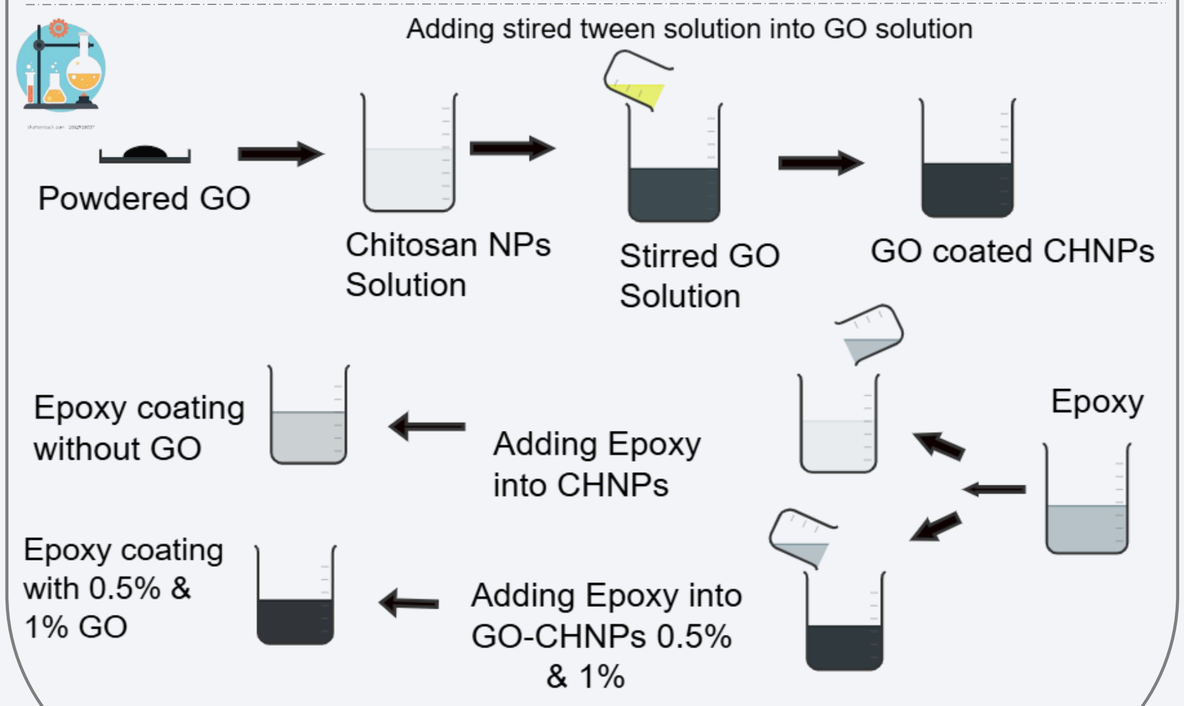


Figure 2 : Schematic representation of the coating preparation process.

REFERENCES

1. A. Farag, "Applications of nanomaterials in corrosion protection coatings and inhibitors," *Corrosion Reviews,* vol. 38, no. 1, pp. 67-86, 2020.
2. L. Muresan, " Nanocomposite coatings for anti-corrosion properties of metallic substrates," *mdpi.com,* vol. 16(14)5092, no. Materials, 2023.
3. S. P. N. M. Şomoghi, "The impact of ZnO nanofillers on the mechanical and anti-corrosion performances of epoxy composites," *mdpi.com,* vol. 16, no. Polymers, p. 14, 2024.

Acknowledgements: This research work was supported by University of Engineering and Technology, Lahore

RESULTS & DISCUSSION

FTIR Analysis

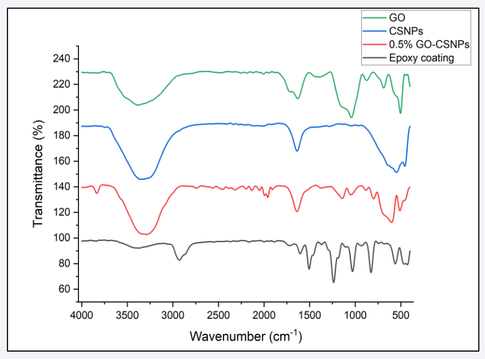


Table 1: Observed peaks and assigned Functional groups

Sample	Observed Peaks (cm^{-1})	Assigned Functional Group
GO	1143	C-O
	1630	C=C
	1711	C=O
	3379	O-H
CSNPs	1048	C-O
	1280	P=O
	1636	C=O (Amide I)
	3341	-OH and -NH
0.5% GO-coated CSNPs	1141	C-O
	1639	N-H
	3286	O-H
Epoxy Resin	823	C-H aromatic
	1028	C-O-C
	1186	C-H (benzenic)
	1239	C-O-C
	1461	CH_2 (scissoring)
	1505	C=C
	2926	C-H (aliphatic)
	3393	C-H aromatic

Figure 3 : FTIR analysis of samples GO, CHNPs, Epoxy+ GO-CHNPs and Epoxy

SEM Analysis

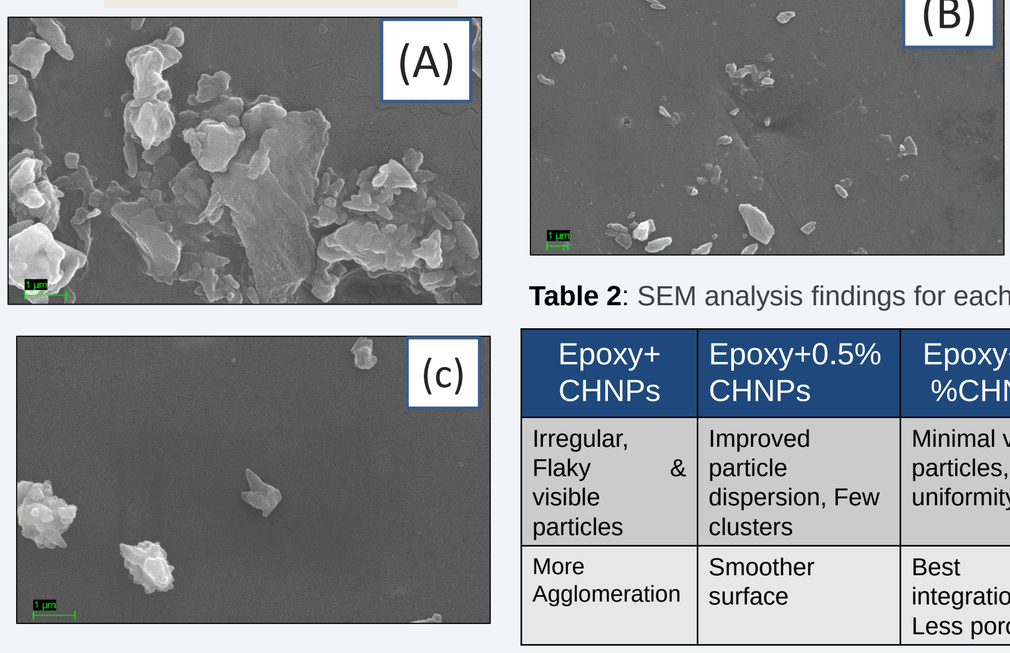


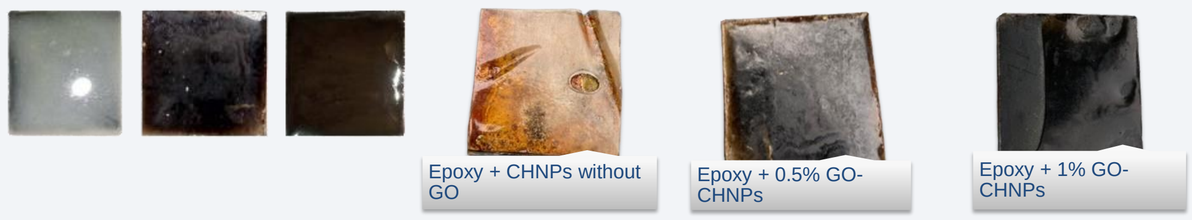
Table 2: SEM analysis findings for each sample

Epoxy+ CHNPs	Epoxy+0.5% CHNPs	Epoxy+0.5 %CHNPs
Irregular, Flaky & visible particles	Improved particle dispersion, Few clusters	Minimal visible particles, uniformity
More Agglomeration	Smoother surface	Best integration, Less porous

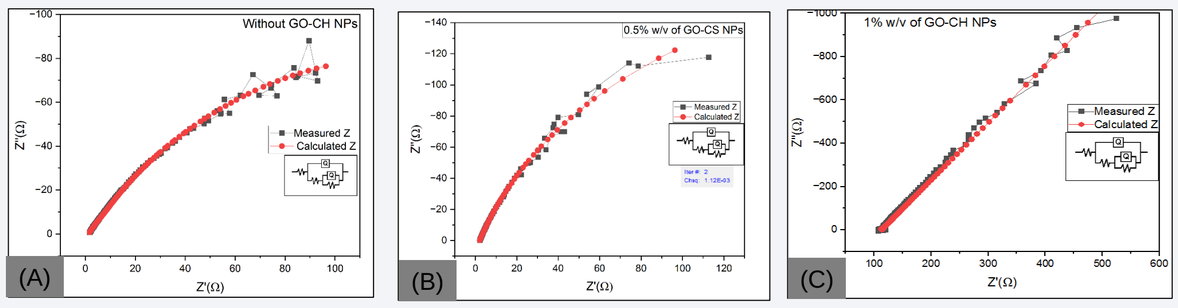
Figure 4 : (A) Epoxy+ CHNPs(without GO) (B) Epoxy+ 0.5% GO-CHNPs (C) Epoxy +1% GO-CHNPs, without GO 380nm, 0.5% sample 342nm, 1% sample 490nm

Visual Corrosion Assessment through Water Immersion Testing

After curing, samples were dipped into water for 12 hrs,we got following results:



EIS Analysis



Highly porous, poor protection, least Rct	Strong barrier with medium Rct value	Least porous with high Rct

Figure 5 : (A) Epoxy+ CHNPs coating without GO (B) Epoxy + 0.5% GO-CHNPs (C) Epoxy + 1% GO-CHNPs, (A) have 112 Ω Rct while 0.5% have 2068Ω & 1% 7498 Ω.

CONCLUSION

- GO–chitosan nanoparticles enhanced coating performance.
- 1% GO coating showed best corrosion resistance & surface quality.
- Hybrid nanocomposite offers a sustainable, high-performance barrier