Insight the composites for electromagnetic shielding applications

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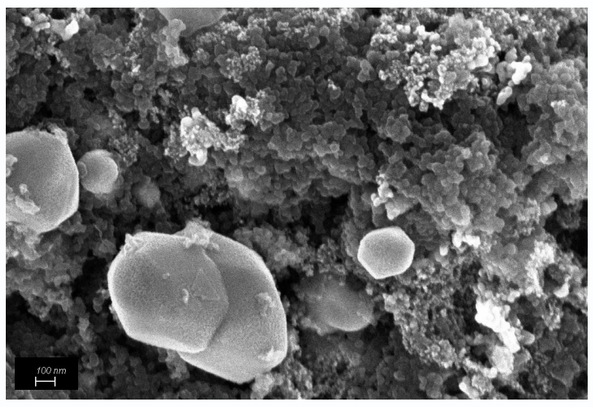
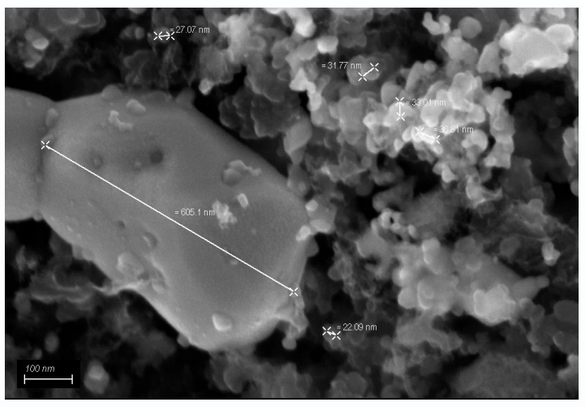
Synthesis

- The filler synthesis involved the production of a hybrid filler to enhance the electromagnetic shielding properties of the epoxy resin matrix.
- The process[1] utilized a carbothermal reduction of iron nitrate dissolved in water, followed by the addition of carbon black.
- The controlled reaction conditions facilitated the creation of highly reactive iron nanoparticles with desirable Fe/C ratios of 0.2, 0.3 and 0.5.

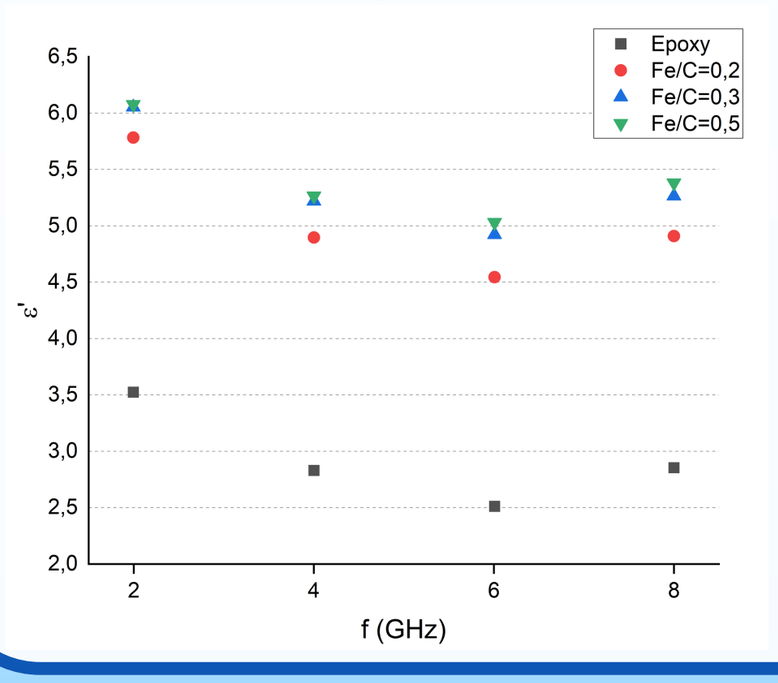
Fesem and EDX analysis

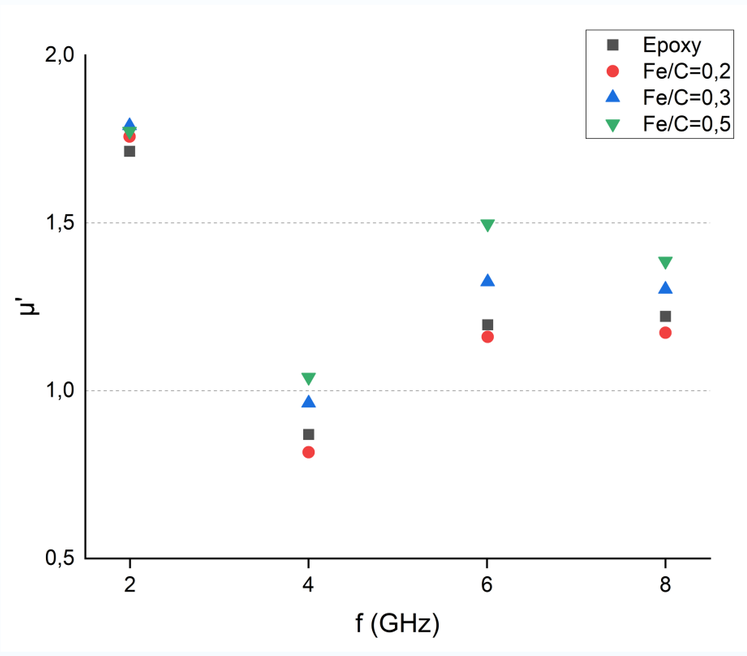




- During the EDX analysis, it was observed that the filler exhibited a higher Fe/C ratio compared to the theoretical value calculated based on the masses of the precursor materials used.
- These variations in the Fe/C ratio can be attributed to the reactivity of the precursors and their carbothermal reduction process.

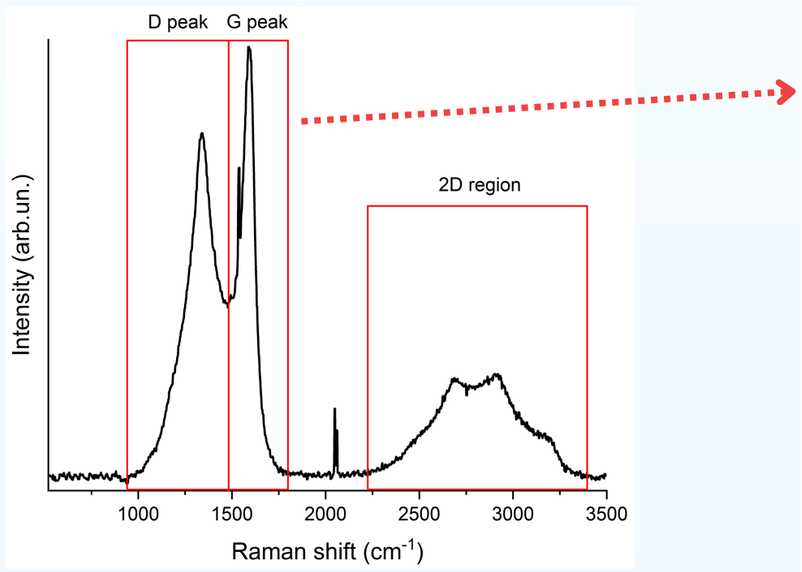
Electromagnetical characterization

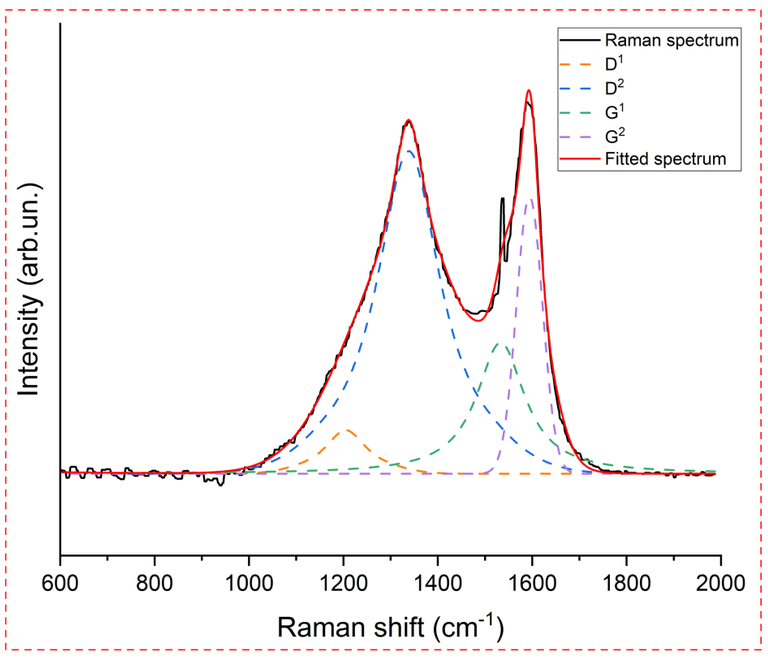




- Composites with 20% of fillers in a epoxy resin.
- Both the dielectric constant (ε') and the magnetic permeability (μ') increase with an increase in the Fe/C ratio of the hybrid filler.

Raman Spectroscopy





Formula[2] used for the evaluation of cluster diameter:

$$\frac{I(D)}{I(G)} = C'(\lambda)L_a^2$$

From the evaluation of the cluster diameter for all powders (Fe/C=0.2, Fe/C=0.3 and Fe/C=0.5), it is possible to say that the degree of carbonisation is the same as there are no significant variations in the I(D)/I(G) ratio.

Conclusion

- By synthesizing a hybrid filler with carefully controlled ratios of inorganic iron nanoparticles and organic carbon black, we have successfully enhanced the electromagnetic shielding properties of the epoxy resin matrix.
- The combination of these components in the filler design has shown promising results for potential electromagnetic shielding applications.

[1] Tamborrino, V., Costamagna, G., Bartoli, M., Rovere, M., Jagdale, P., Lavagna, L., ... & Tagliaferro, A. (2021). Catalytic oxidative desulphurization of pyrolytic oils to fuels over different waste derived carbon-based catalysts. Fuel, 296, 120693 (2021).
[2] Ferrari, A.C. and J. Robertson, Interpretation of Raman spectra of disordered and amorphous carbon. Physical Review B, 2000. 61(20): p. 14095-14107.