Development of a Conductive Scaffold, Incorporating Reduced Graphene Oxide and Metatitanic Acid Nanoparticles for Enhanced Tissue Regeneration

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கொழும்புப் பல்கலைக்கழகம்
UNIVERSITY OF COLOMBO

Commonwealth Chemistry
Federation of Chemical Sciences Societies

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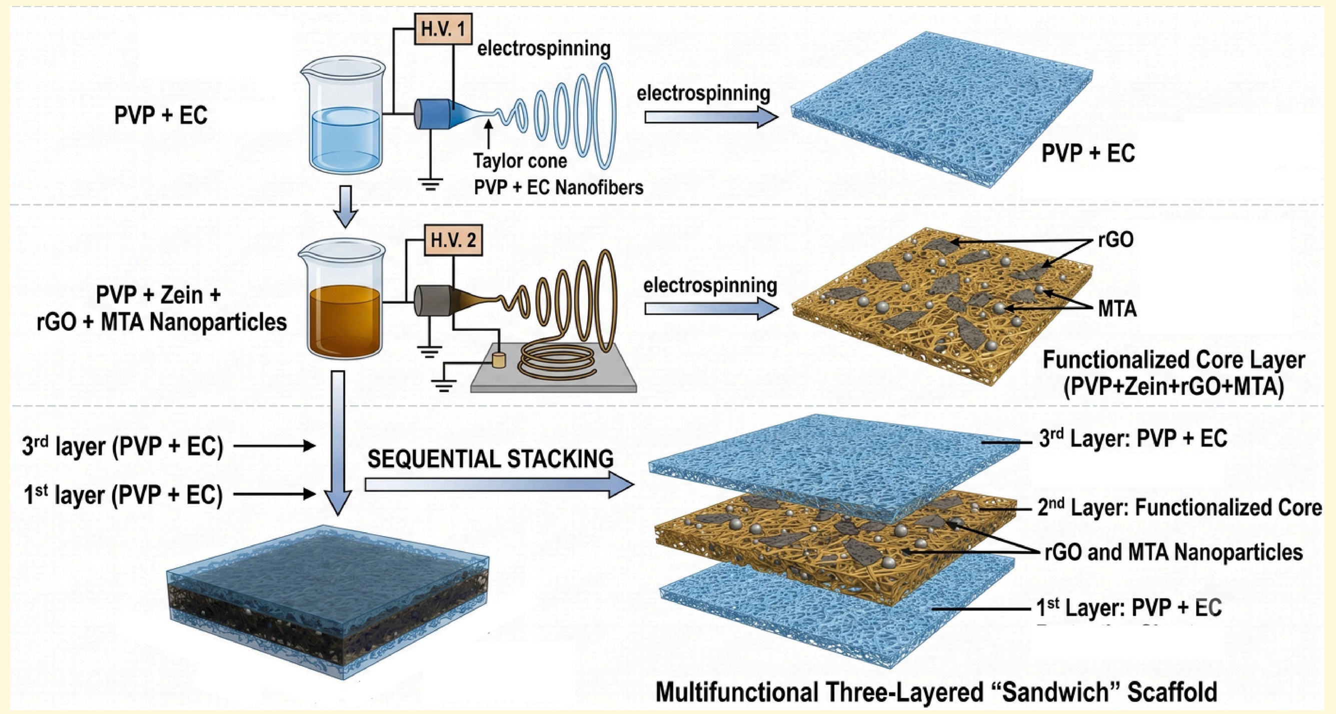
INTRODUCTION

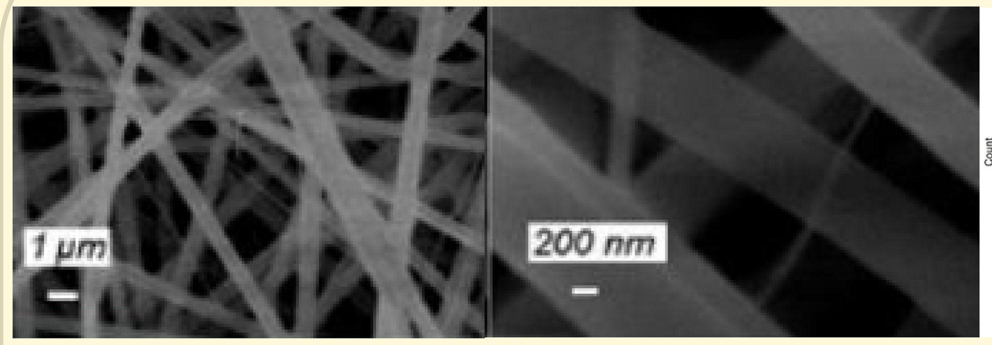
Developing interfaces that combine structural support with electrophysiological functionality is a major challenge in tissue regeneration. To address this, a multifunctional, three-layered "sandwich" scaffold was fabricated via electrospinning using Zein, PVP, and EC polymers, functionalized with rGO and metatitanic acid nanoparticles. This tiered structure ensures controllable release kinetics and core protection, with its properties and performance validated through comprehensive spectroscopic characterization (SEM, FTIR, XRD, Raman) and diverse biological and electrochemical assays (including FET, hemocompatibility, and antibacterial testing).

PREPARATION

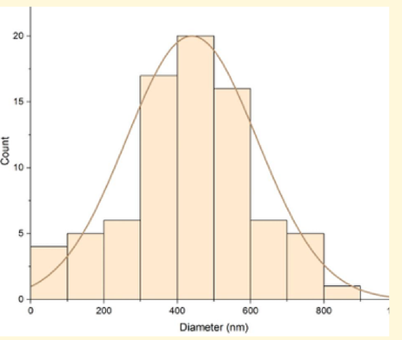


RESULTS

Morphology of the Scaffold

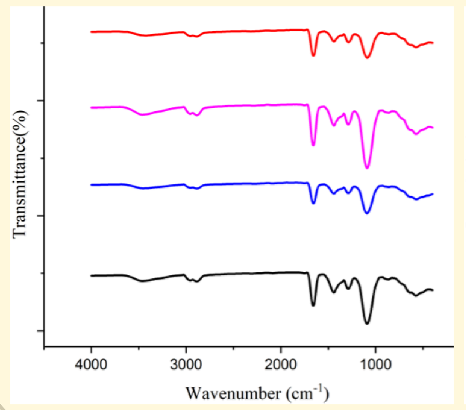


Nanorange, bead free non woven nanofibres

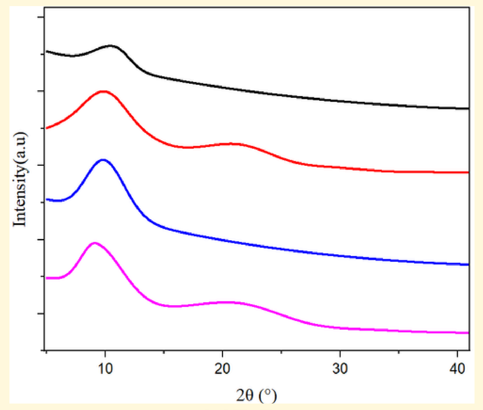


Mean fiber diameter was 439.79 ±178.87 nm

Characterization of the Stratified Scaffold

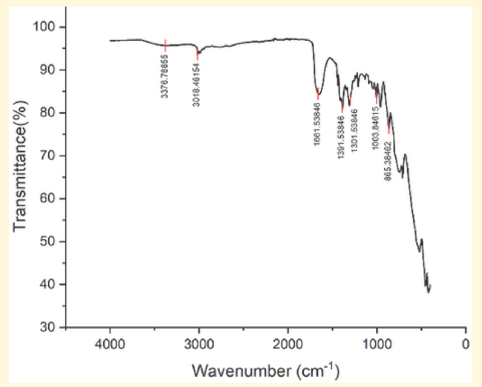


FTIR

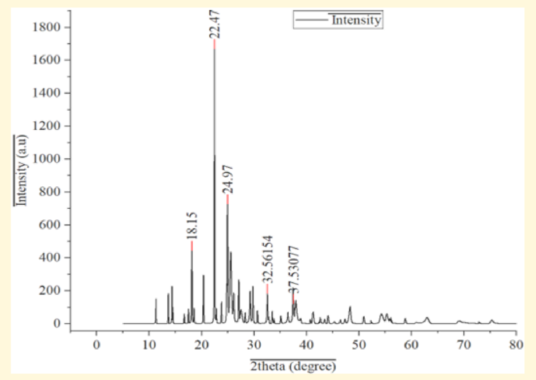


XRD

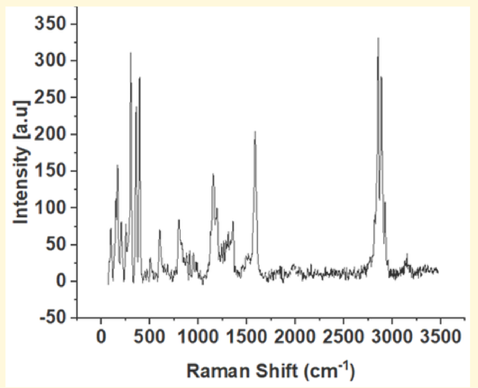
Characterization of MTA Nanoparticle



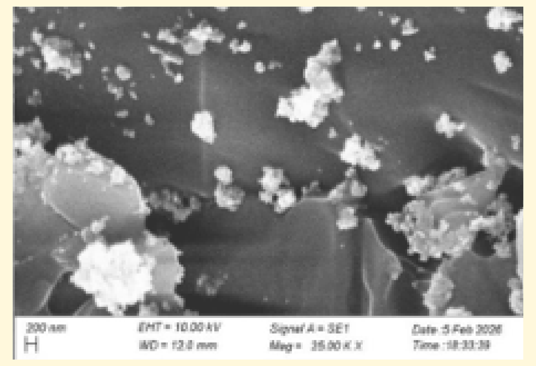
FTIR



XRD

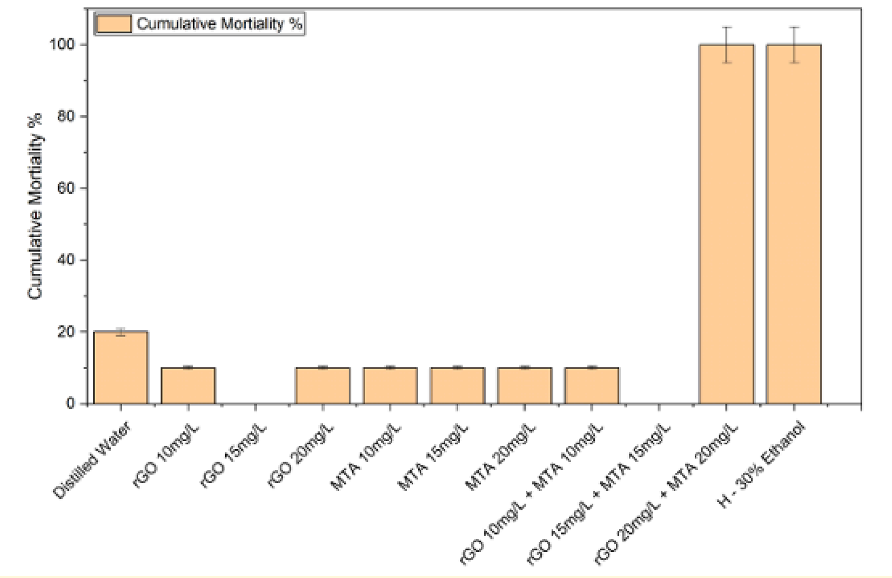


Raman



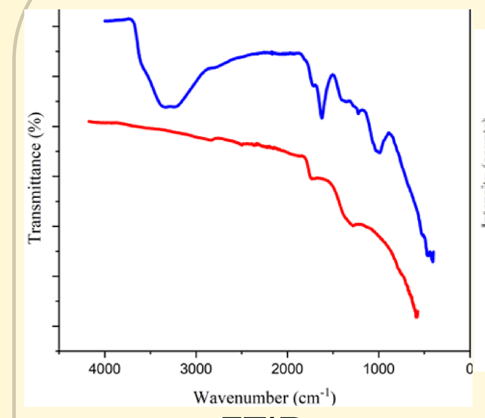
SEM

In Vivo Zebrafish Embryo Toxicity

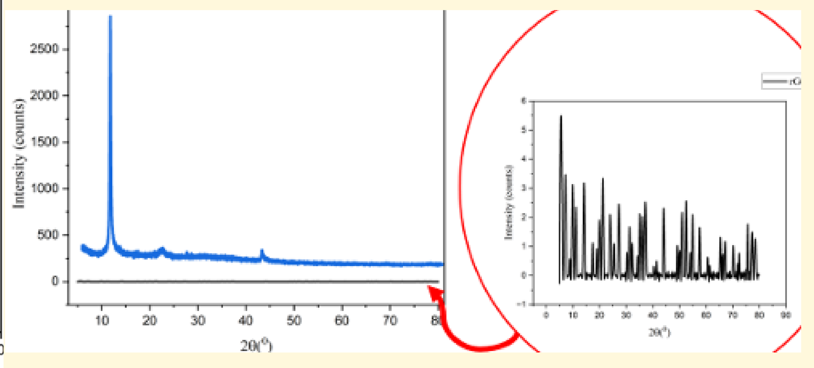


0% Mortility rate at 15mg/L rGO + MTA

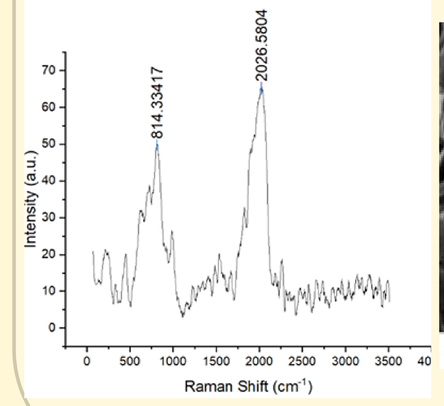
Characterization of rGO Nanoparticle



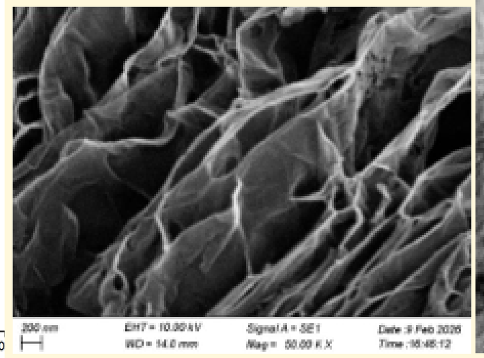
FTIR



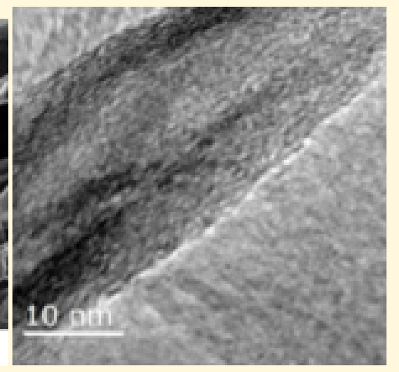
XRD



Raman

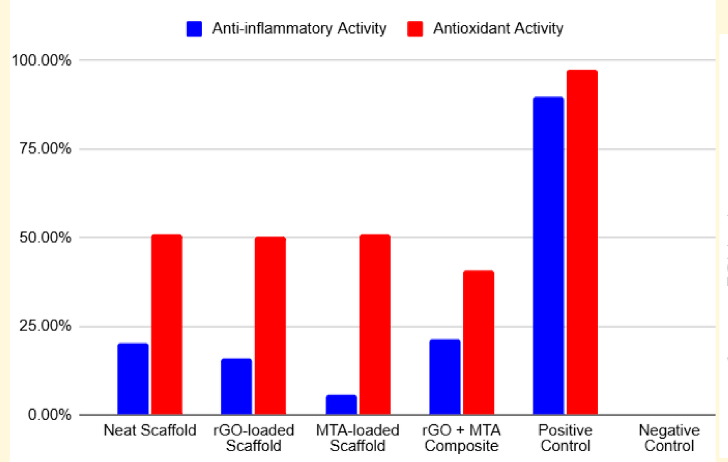


SEM

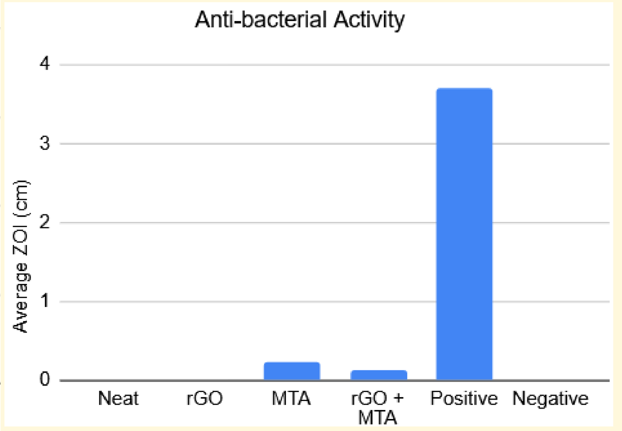


TEM

Bioactivity

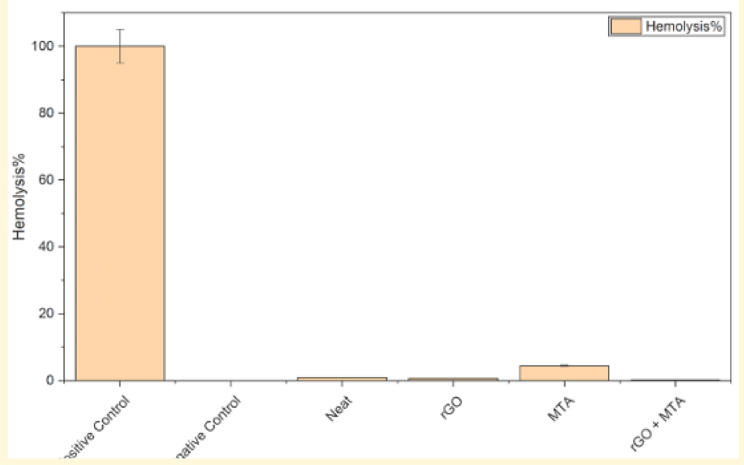


40.70% antioxidant and 21.40% anti-inflammatory activity, reducing oxidative stress and modulating the inflammatory microenvironment.



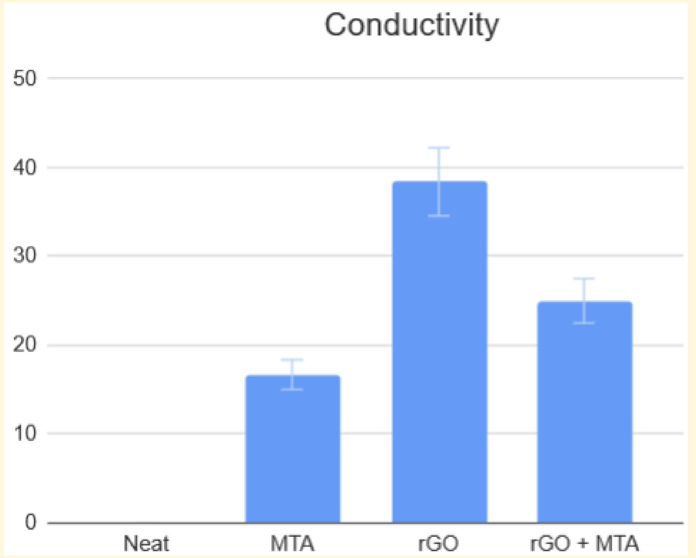
Significant efficacy due to MTA incorporation.

Hemocompatibility

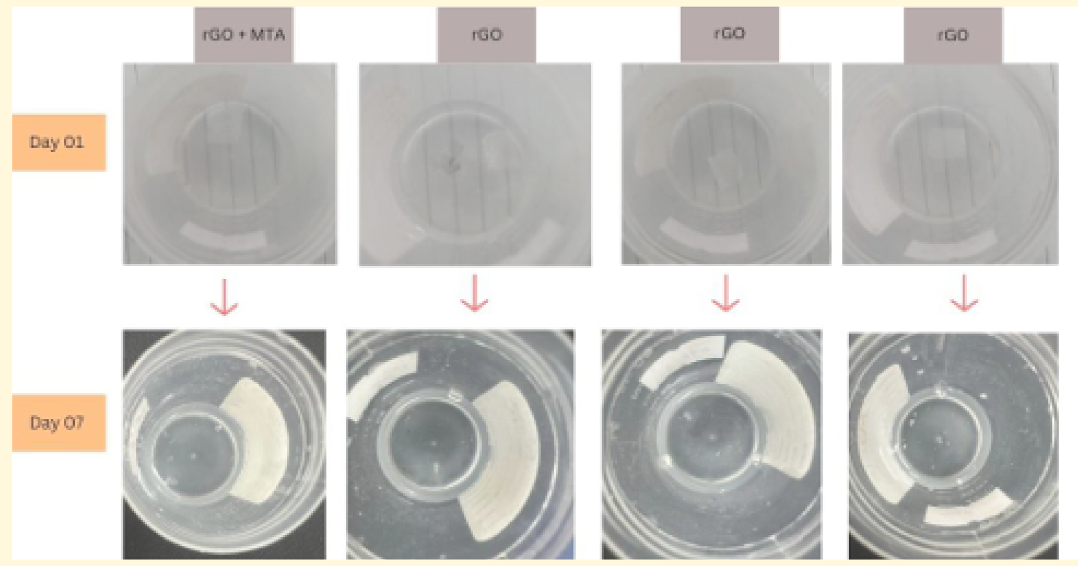


Safe for Blood contacting applications

Physiological Studies



Significant conductivity (by incorporating rGO) for electrically stimulated repair.



Fragmentation behavior at the macroscopic level, stable physiological pH (reduced acidosis risk).

CONCLUSION

A three-layered, electrospun "sandwich" scaffold was successfully engineered, combining structural biocompatibility with electrical conductivity. By protecting the core and ensuring controlled release, the scaffold exhibits significant antioxidant, anti-inflammatory, and antibacterial activities, making it a highly promising candidate for electrically stimulated soft tissue engineering.

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