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Supramolecularly Reinforced Hydrogel for Advanced Tissue Engineering

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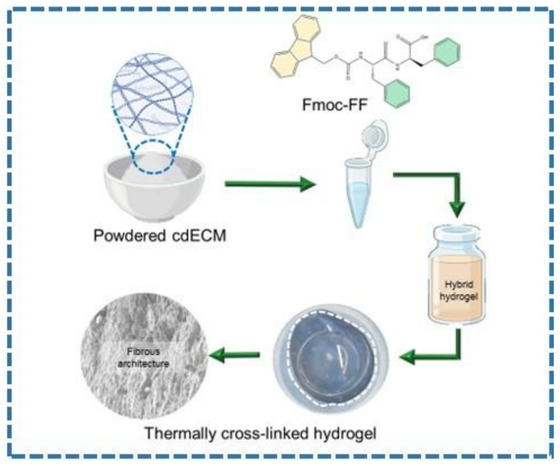
INTRODUCTION & AIM

- Biomimetic hydrogels have advanced cartilage regeneration by mimicking native Extracellular matrix (ECM) and supporting chondrocyte function. Current hydrogels/scaffolds does not offer all the properties like structural hierarchy, mechanical strength, and biochemical complexity which will lead to cartilage tissue engineering.
- dECM hydrogels preserve native biochemical cues but show limited mechanical tunability, impacting their clinical use. While a small gelator, Fmoc-FF, which forms β-sheet nanofibrils resembling amyloid-like supramolecular structures, can enhance mechanical properties by forming the supramolecular assembly with dECM components.
- This study aims to explore the efficiency of the hybrid hydrogel based on Decm-FF and its potential clinical use for cartilage tissue engineering.

METHOD



RESULTS & DISCUSSION

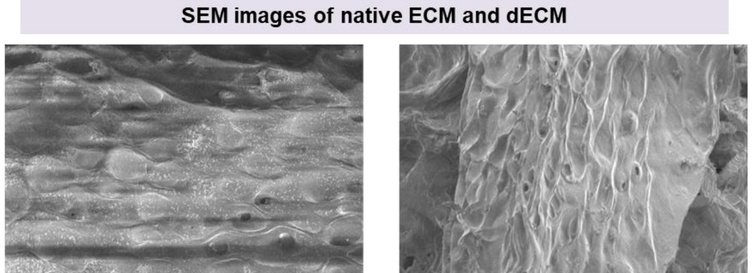
dECM Hydrogel

Frequency Sweep

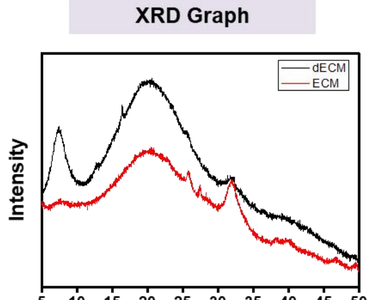
Strain Sweep

FTIR Spectra

SEM images of native ECM and dECM



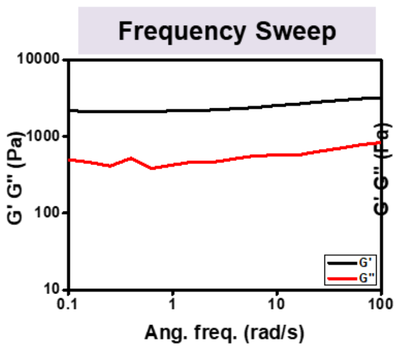
XRD Graph



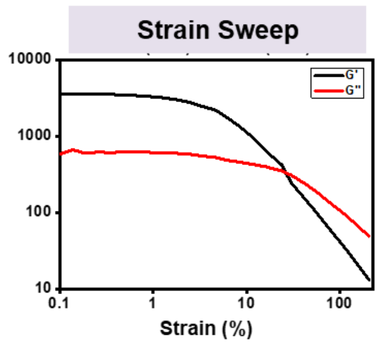
RESULTS & DISCUSSION

Hybrid Hydrogel

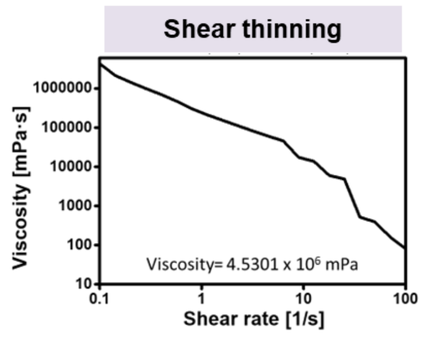
Frequency Sweep



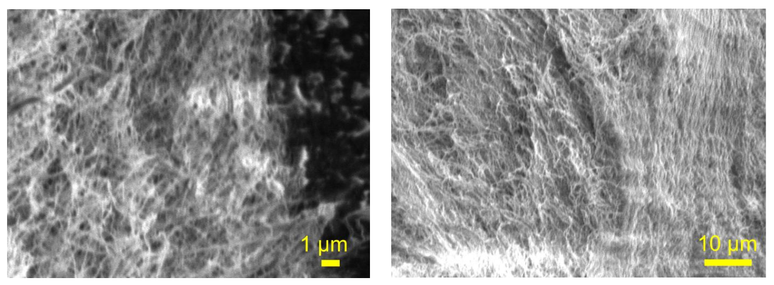
Strain Sweep



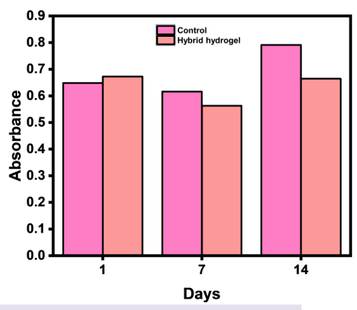
Shear thinning



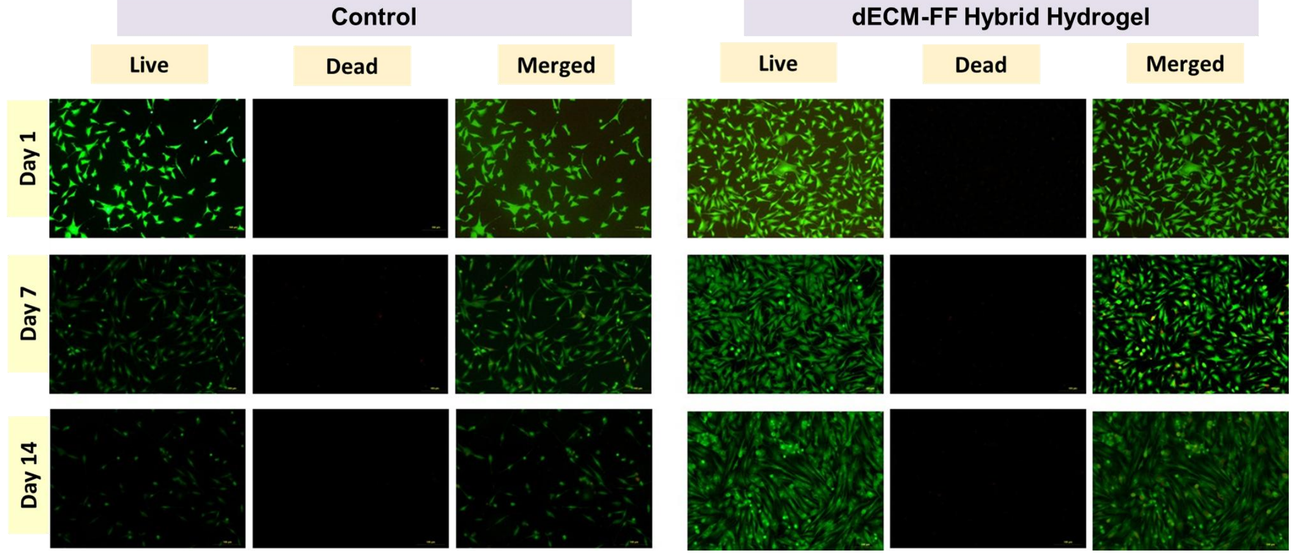
SEM Images Showing Fibrous Architecture



Cell Proliferation assay



Supports Chondrocyte Proliferation



CONCLUSION

- This study shows that dECM–Fmoc-FF hybrids provide native ECM-derived cues that enhance chondrocyte viability, matrix deposition, and cartilage-like phenotype maintenance.
- The hybrid network shows improved mechanical integrity, supporting load-bearing conditions relevant to cartilage repair.
- Supramolecular peptide assembly introduces hierarchical structure conducive to tissue maturation and extracellular matrix organization.
- dECM components modulate peptide assembly to create microenvironments that closely mimic native cartilage architecture.
- These hydrogels show strong potential for cartilage regeneration, with future *in vivo* studies needed to assess integration, long-term stability, immunomodulatory effects, and functional restoration of cartilage defects

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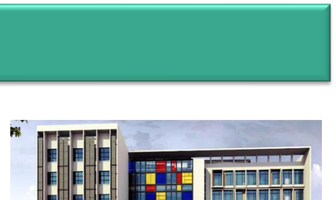

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