Light Processing(DLP) Printed, Bioactive Chondroitin Sulfate Hydrogels for Cartilage Tissue Engineering

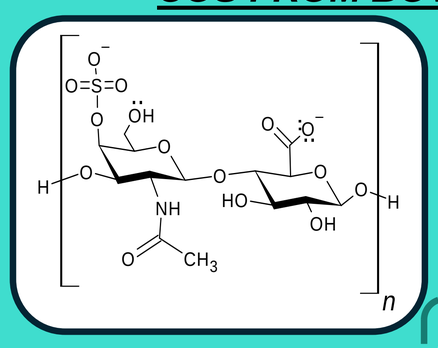
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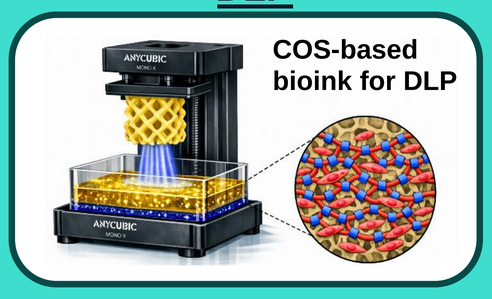
INTRODUCTION

COS FROM BOVINE TRACHEA



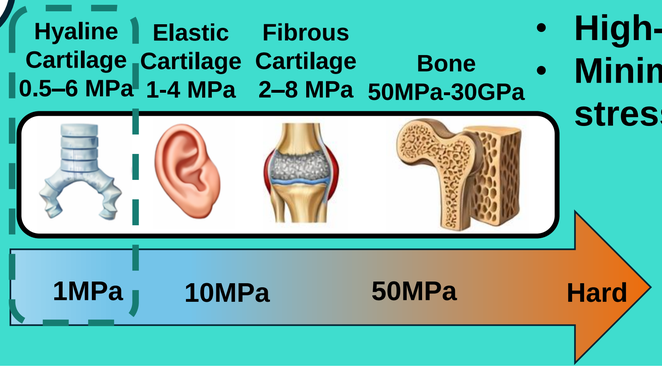
- GAG abundant in cartilage (~30%)
- High compressive stiffness
- Water retention

DLP



- High-resolution
- Minimal shear stress on cells

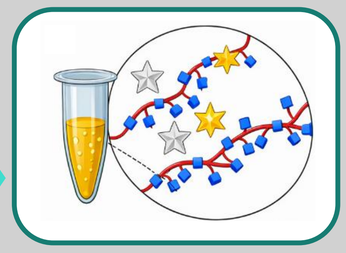
MECHANICAL STIFFNESS



METHODOLOGY

1) COS METHACRYLATED (COS-MA) and COS WITH HISTIDINE (COS-His)

2) FORMULATION→DLP

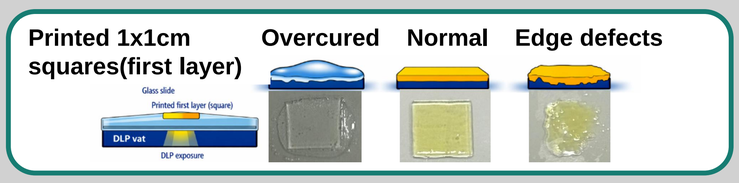


Polysaccharide (COS-MA 24%w/v)

Photoinitiatior (LAP 0,5%w/v)

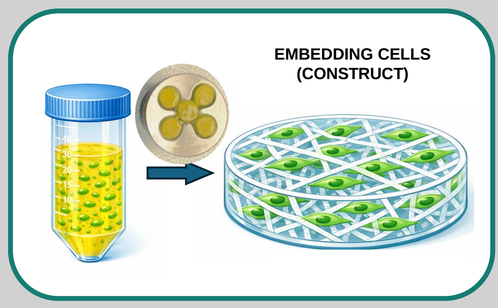
Photoabsorber (Tartrazine 2%/mol LAP)

3)PRINTING: WORKING CURVE FOR DLP



4)POST PRINTING→ MECHANICAL PROPERTIES

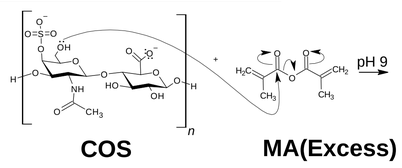
5) BIOPRINTING (Metabolic activity ATP CELL TITER and LIVE/DEAD, using hMSC cells)



RESULTS & DISCUSSION

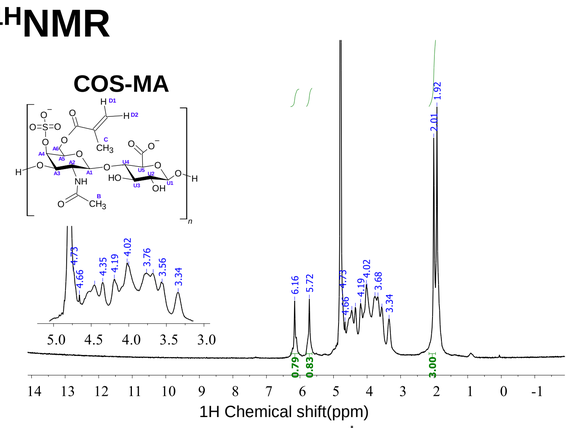
CHARACTERIZATION BY ^{1H}NMR

COS-MA DoF=81%

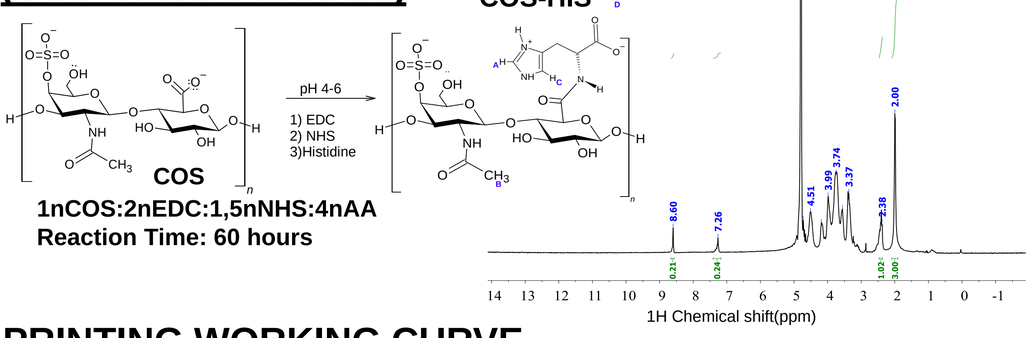


Reaction time: 48hours

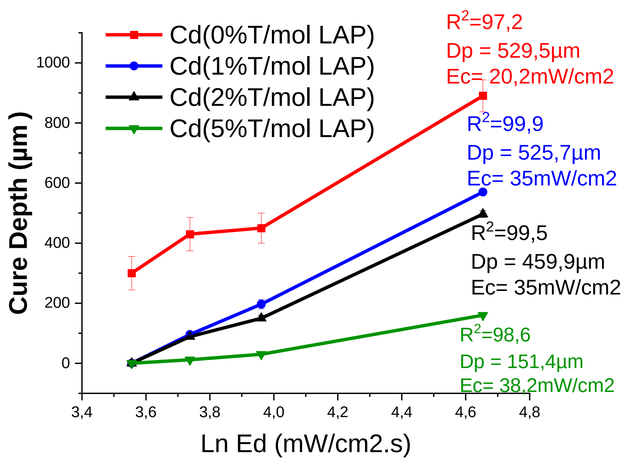
Ester formation (stable): nucleophilic attack by -OH



COS-HIS DoF=22,5% (COS-GRGDS MODEL)



PRINTING WORKING CURVE



%Tartrazine: 2%T/mol LAP

Exposure time:15sec/layer

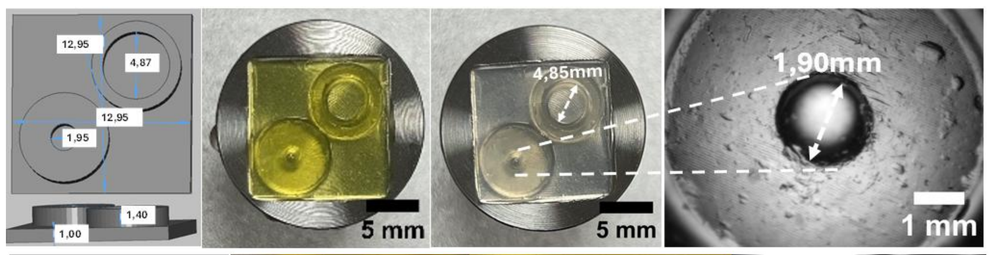
Radiance Printer: 3,55mW/cm²

Gelling point: 0%T(61s);2%T(64 s)

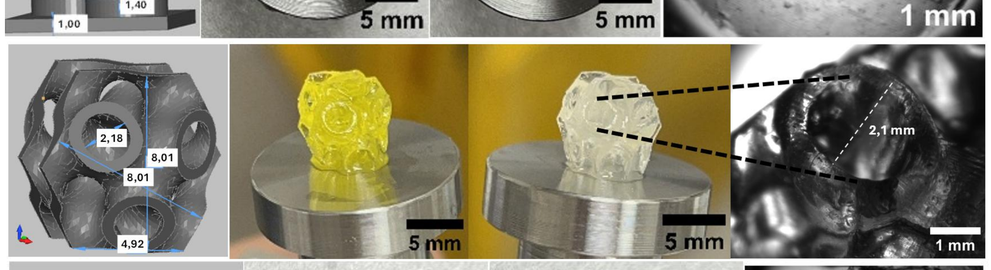
Printability: Value close 1

Resolution: 150µm

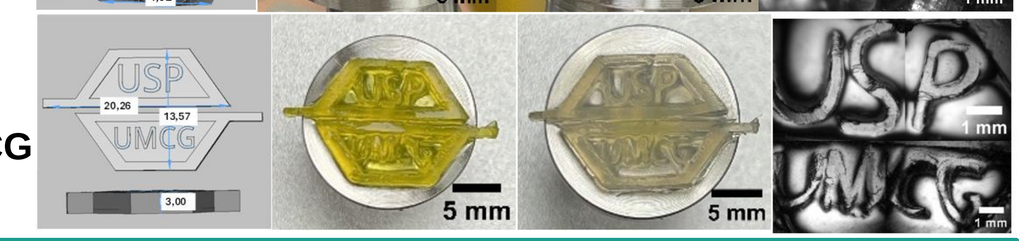
LEGO



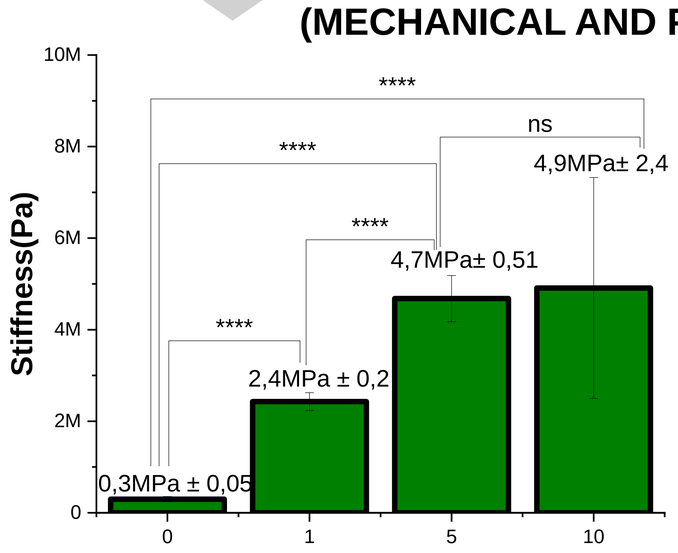
GYROID

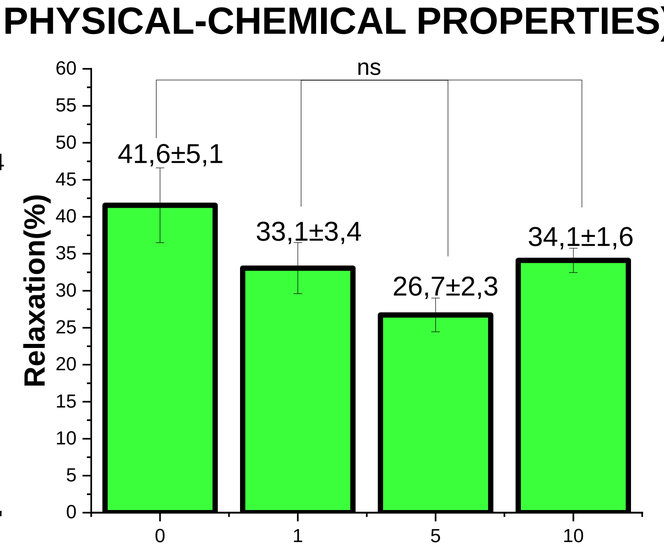


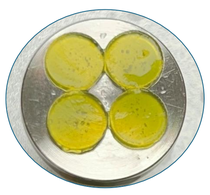
LOGO USP-UMCG



POST PRINTING (MECHANICAL AND PHYSICAL-CHEMICAL PROPERTIES)







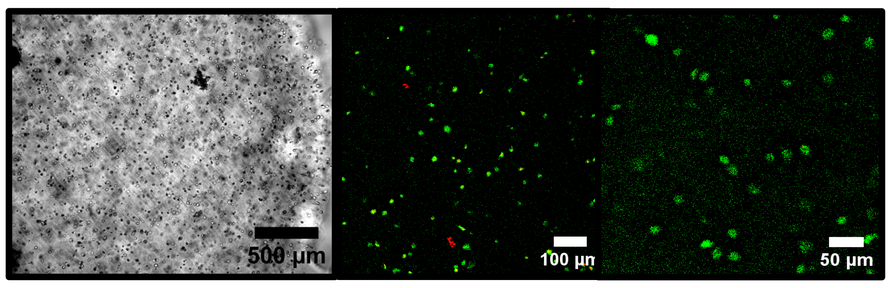
✓Above 85% gel fraction at all post-processing times

✓Degradation and swelling testing(1 month): good material stability, maintaining 90% of its mass ; ~300% swelling (dry ≠ swelling)

BIOPRINTING AND BIOFABRICATION

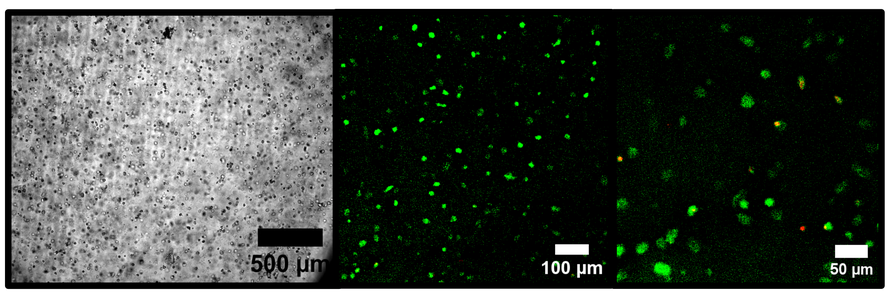
CONSTRUCT LIVE/DEAD

POST CURING

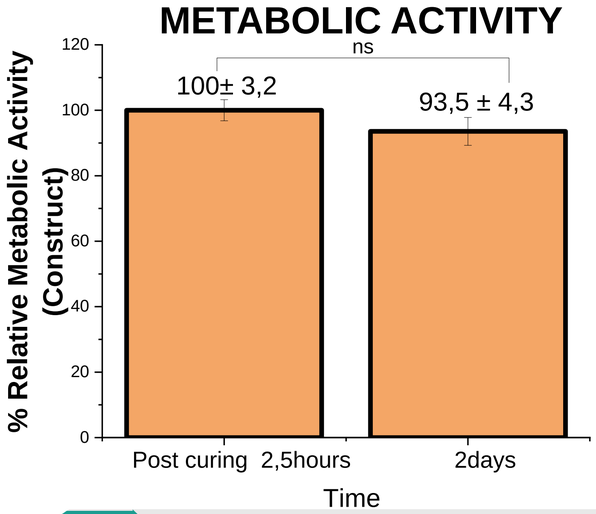




2 DAYS



METABOLIC ACTIVITY



✓ Metabolic activity above 90% for up to 2 days

✓ The material is not cytotoxic even after DLP printing

CONCLUSION AND NEXT STEPS

COS-MA DoF 80% and the studied formulation has stiffness similar synthetic polymers (MPa), providing high print resolution without losing its biocompatibility (Construct for embedding cells).

→ Ongoing studies are evaluating the improvement in cell viability and bioactive with the incorporation of COS-GRGDS.

ACKNOWLEDGEMENTS