SMART MCs

SilkMA Material Characterisation

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Smart MCs SIlkMA

SilkMA (Silk Fibroin Methacryloyl) is a photocurable hydrogel derived from methacrylated silk fibroin. Modified with glycidyl methacrylate to introduce reactive double bonds, SilkMA transforms silk fibroin, a highly crystalline and water-insoluble protein, into a water-soluble material that cures rapidly under visible light. It combines the strength and biocompatibility of natural silk with tunable mechanical properties, making it ideal for applications such as tissue engineering, wound healing, and 3D bioprinting

- Fast Gelation cures under visible light in under 10 seconds
- Enhanced Solubility water-soluble after modification for easy formulation
- Tunable Mechanics supports a wide range of viscoelastic properties
- Biocompatible and Biodegradable safe for in vivo and in vitro use
- High Strength retains mechanical robustness of natural silk
- Composite Compatibility works with hydrogels such as GelMA and HAMA
- Scalable and Stable consistent quality ensured through strict processing

1. General Information

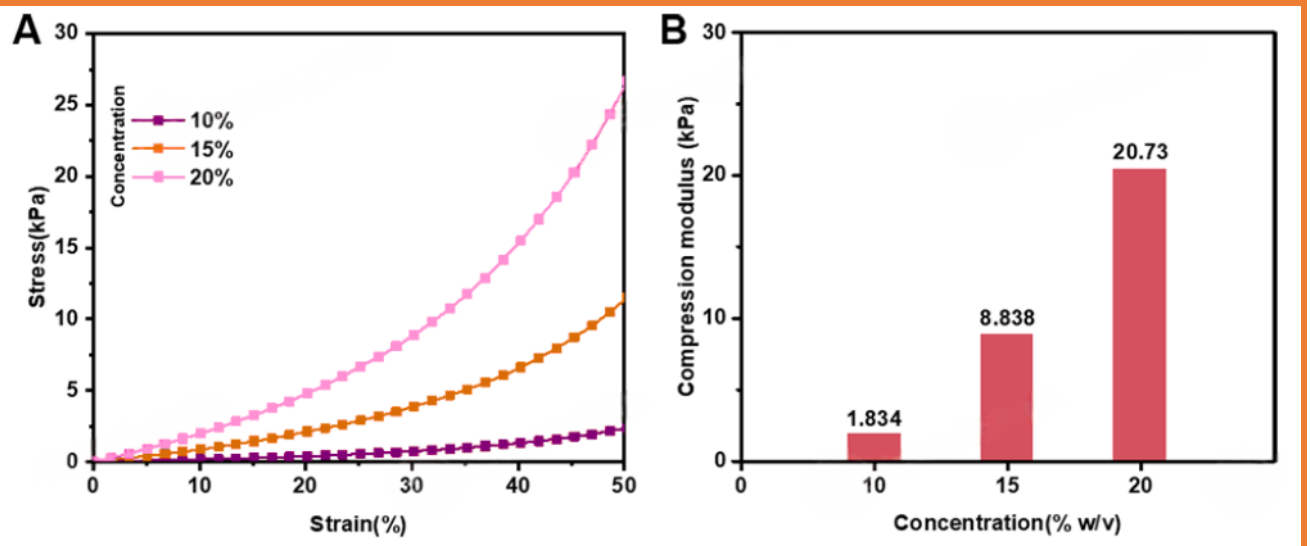
Model	Silk Type	Form	Appearance	Specifications
SilkMA	Bombyx mori silk	White, sponge-like	White spongy	1 g/vial, includes 0.05 g LAP photoinitiator 5 g/pack, photoinitiator not included 10 g/pack, photoinitiator not included

2. Compressive Modulus

Compressive modulus reflects the hydrogel's ability to resist deformation. SilkMA's stiffness increases significantly with concentration, ranging from soft (1.83 kPa at 10%) to firm scaffolding structures (20.73 kPa at 20%).

SilkMA Concentration (%)	Compressive Modulus (kPa)
10	1.834
15	8.838
20	20.73

Figure 1: Mechanical Properties of SilkMA Hydrogels: Compression and Stress–Strain Analysis of SilkMA



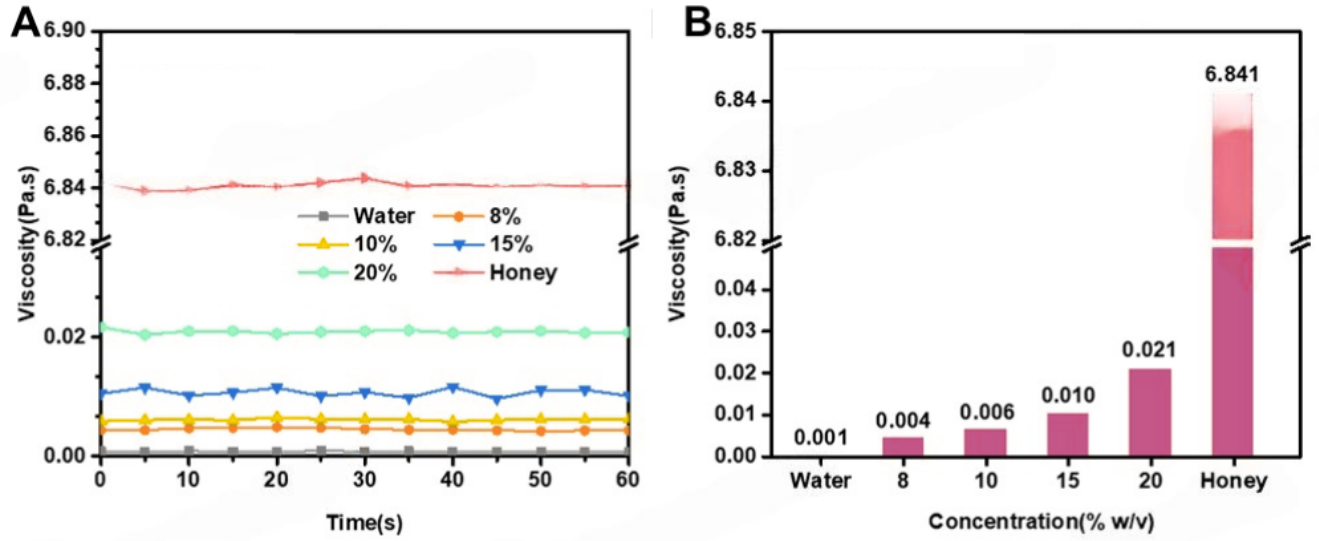
(A) Stress–strain curves across varying concentrations highlight the concentration-dependent mechanical response of SilkMA hydrogels
(B) Corresponding compressive modulus values demonstrate tunable stiffness ranging from 1.83 kPa to 20.73 kPa depending on formulation

3. Viscosity Comparison

Viscosity directly influences printability and flow behaviour. SilkMA exhibits low viscosity across all concentrations (e.g., 0.004 Pa·s at 8% to 0.021 Pa·s at 20%), supporting smooth extrusion while maintaining structural fidelity.

SilkMA Concentration (% w/v)	Viscosity (Pa•s)
8	0.004
10	0.006
15	0.010
20	0.021
Honey (control)	6.841
Water (control)	0.001

Figure 2: Viscosity Profile of SilkMA



(A) Time-dependent viscosity measurements of SilkMA hydrogels demonstrate stable viscosity profiles across all concentrations during the 60-second measurement period

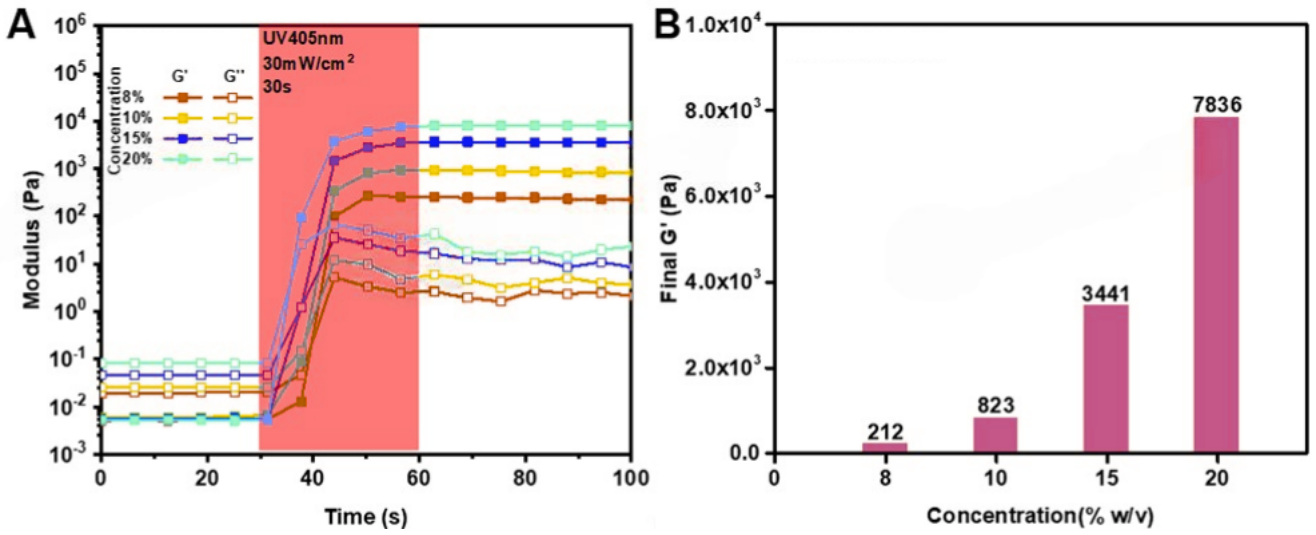
(B) Static viscosity values increase with concentration, confirming the concentration-dependent flow behaviour of SilkMA. Water and honey were included as reference materials for comparison

4. Storage Modulus Comparison

Storage modulus indicates the elastic strength post-curing. SilkMA shows rapid gelation and increasing G' values from 212 Pa at 8% to 7,836 Pa at 20%, offering good mechanical integrity for printed or cast structures.

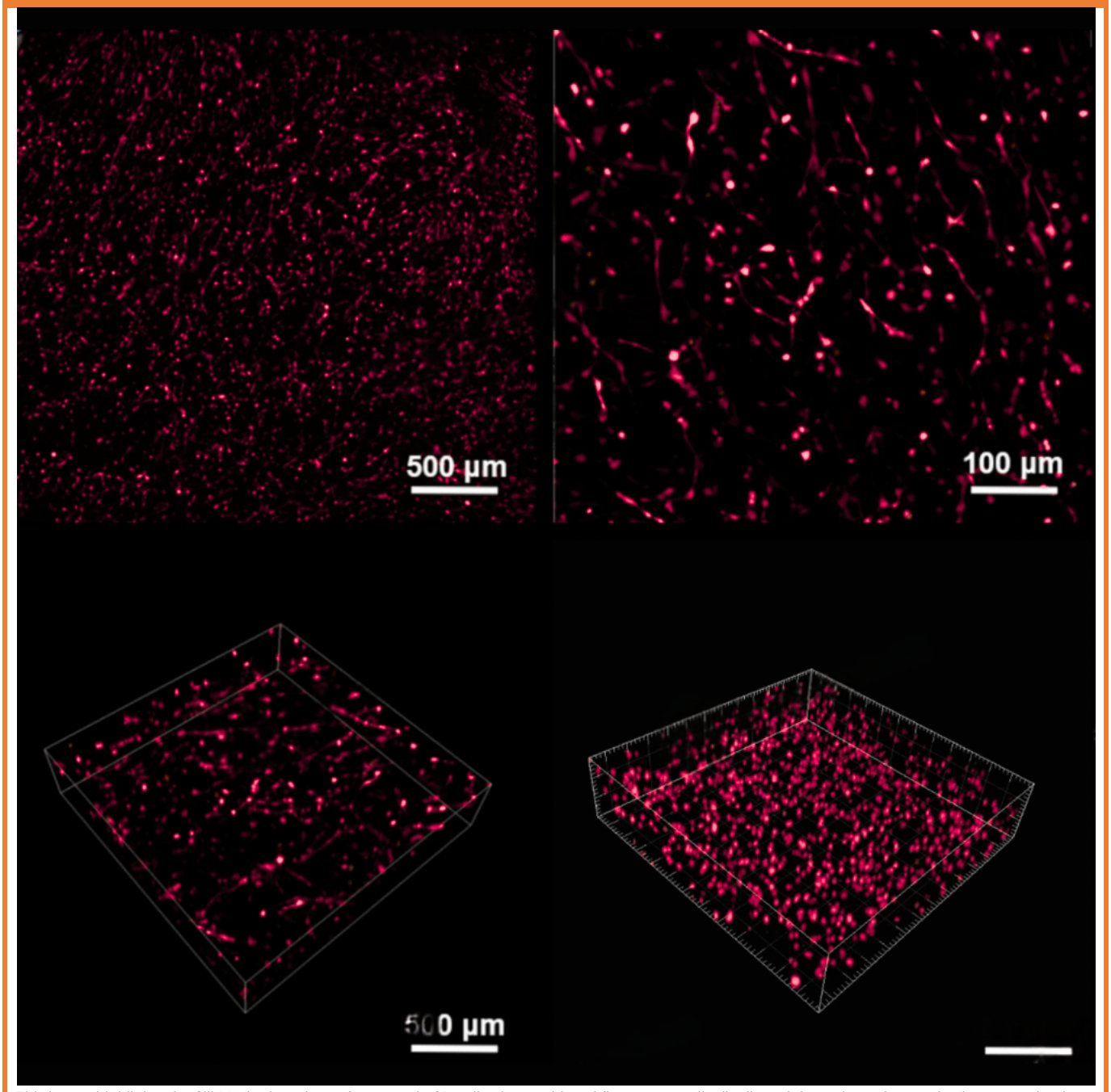
SilkMA Concentration (% w/v)	Storage Modulus G' (Pa)
8	212
10	823
15	3441
20	7836

Figure 3. Storage Modulus (G') of SilkMA Hydrogel Following Photocuring



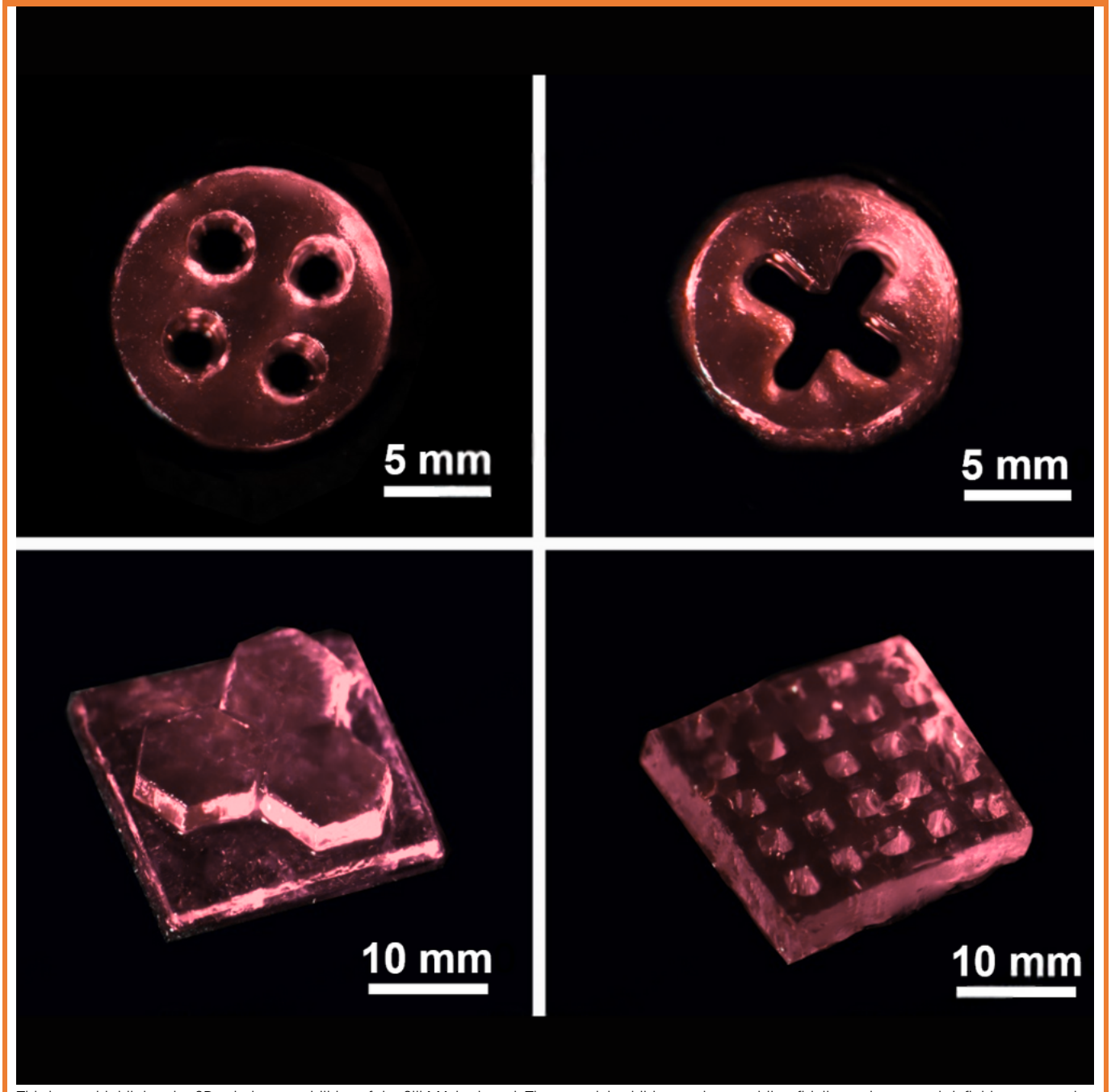
(A) Modulus measurements over time show rapid gelation under UV light (405 nm, 30 mW/cm² for 30 seconds)
(B) Final G' values increase with concentration, demonstrating tunable stiffness of SilkMA hydrogels

Figure 4. SilkMA Hydrogel 3D Cell Culture



This image highlights the SilkMA hydrogel's performance in 3D cell culture, with red fluorescent cells distributed throughout the matrix, demonstrating its biocompatibility and support for cell encapsulation and spatial organisation.

Figure 5. SilkMA Hydrogel 3D Printing Performance



This image highlights the 3D printing capabilities of the SilkMA hydrogel. The material exhibits precise moulding fidelity and structural definition, supporting its suitability for digital light processing (DLP) printing in fabricating intricate and high-resolution designs.