

3D printing with heat-curing hydrogels based on chitosan and β -glycerophosphate

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1. NMR study

The ^{13}C NMR experiments were conducted in solid state at room temperature with the Avance III 400WB solid state NMR spectrometer (Bruker, Switzerland) (magnetic field of 9.4 T) using a 4-mm CP/MAS probe. The resonance frequency was 100.64 MHz.

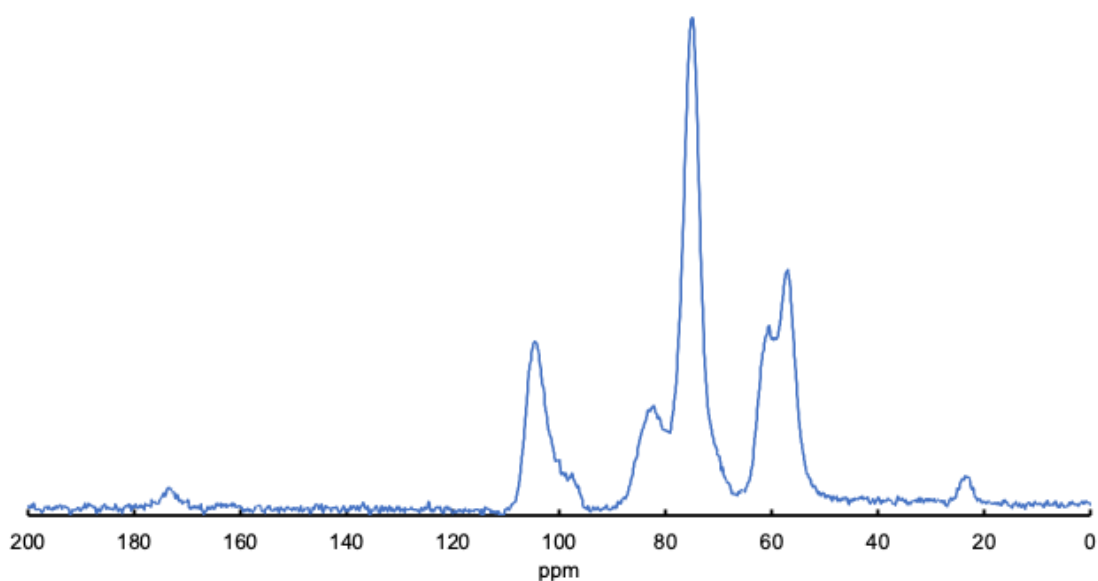


Figure S1 Solid state ^{13}C NMR spectra of CS with molecular weight 148 kDa.

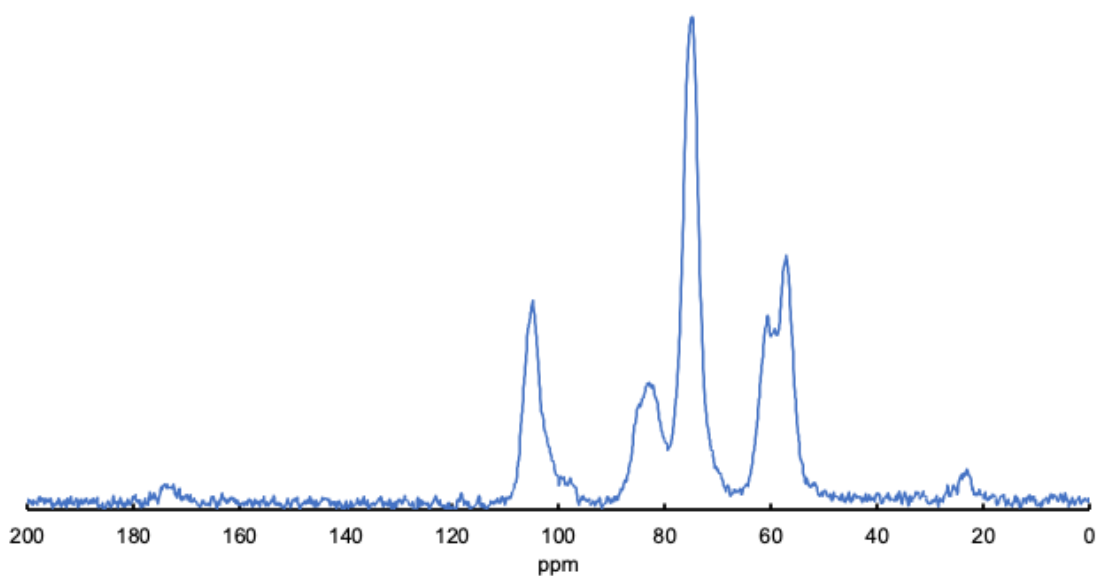


Figure S2 Solid state ^{13}C NMR spectra of CS with molecular weight 164 kDa.

2. Rheological studies

The change in viscosity of CS/GP water solutions was measured on a rotational viscometer Reotest-2 (VEB MLW, Germany) in the temperature range from 20 to 40 °C. In the case of 2% and 3% solutions, the measurements were carried out at an engine speed of 3 s⁻¹, and in the case of 1% solutions at 27 s⁻¹.

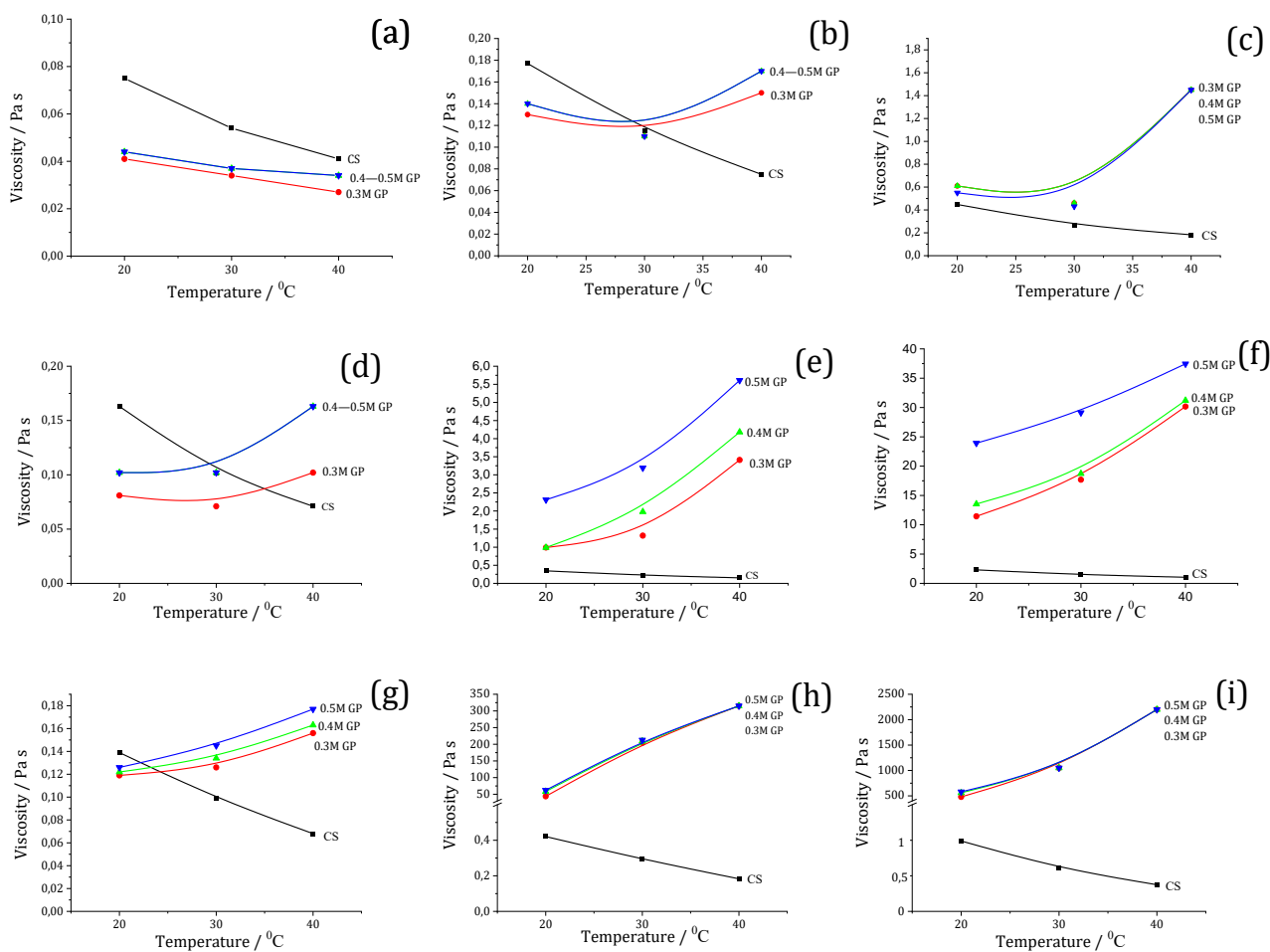


Figure S3 Viscosity versus temperature curves for CS with molecular weight 148 kDa: (a) 1% solution, (b) 1.5% solution, (c) 2% solution; for CS with molecular weight 900 kDa: (d) 1% solution, (e) 1.5% solution, (f) 2% solution; for CS with molecular weight 164 kDa: (g) 1% solution, (h) 1.5% solution, (i) 2% solution.

3. 3D printing

3D printing was carried out on 3D BioScaffolder BS3.2 (GeSiM, Radeberg, Saxony, Germany) with pneumatic extrusion. Nozzles with a diameter of 410 μm were used. The composition was printed to glass covered with aluminum foil on table, heated up to 40 °C.

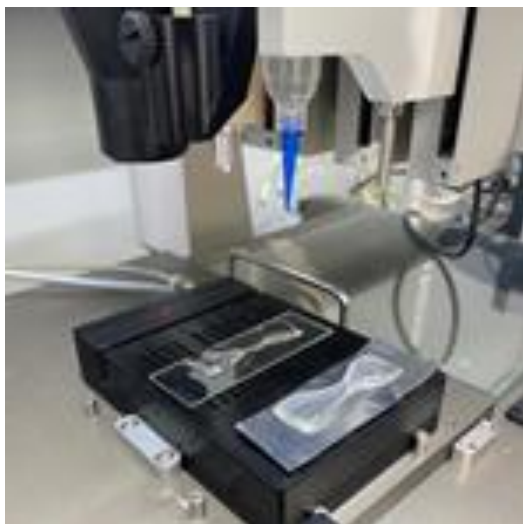


Figure S4 3D printing of hydrogel dog-bone samples.

4. Mechanical tests

The mechanical tests of the dog-bone-like samples (3x15 mm) were carried out in uniaxial extension mode at room temperature using the AG-100kNX Plus universal mechanical test system (Shimadzu, Kyoto, Japan). The samples were stretched at a rate of 20 mm/min, according to ASTM D638 requirements. The stress–strain curves of the samples were registered during the tests. The Young's modulus, break stress and ultimate deformation were determined. Average values and standard deviations were calculated based on measurements of 3 samples.