Soft Matter

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ESI: Flax fibre reinforced alginate poloxamer hydrogel: assessment of mechanical and 4D printing potential

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This supplementary material presents the printing paths and geometries for the different tests conducted. It also provides a detailled procedure for the production of the composite hydrogels studied. Examples of stress strain curves for the tensile, rheology and annulus scaffold compression tests are also provided.

1 Hydrogel production

Tab. S1 The different steps of production of the hydrogel. The ingredients are added from top to bottom. Stock 1 was produced by heating the mixture in the autoclave for 12h. 24h in the fridge was necessary before the mixture to be used. The stock 2 was obtained by mixing the ingredient twice one minute at 3500rpm in a DAQ mixer with manual mixing in between. Finally the printing material was obtained by mixing the material twice for 5 minutes at 3500rpm with manual mixing in between. All these different steps were conducted at room temperature.

Stock 1	Stock 2	Print Material
Poloxamer 29.95wt%	Stock 1 66wt%	Stock 2 66.7%wt
Water 70.05wt%	Sodium Alginate 9wt%	Flax Fibre *n*wt%
/	Water 25wt%	Water 23.3-*n*%wt
/	/	$CaCl_2$ 10%wt

2 Printing path and geometry

2.1 Tensile test

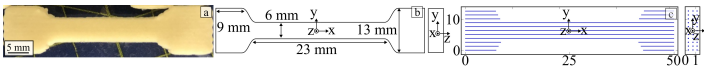

Fig. S1 Tensile test specimens. a): Printed specimens b): Printing dimensions c): Printing path in mm.

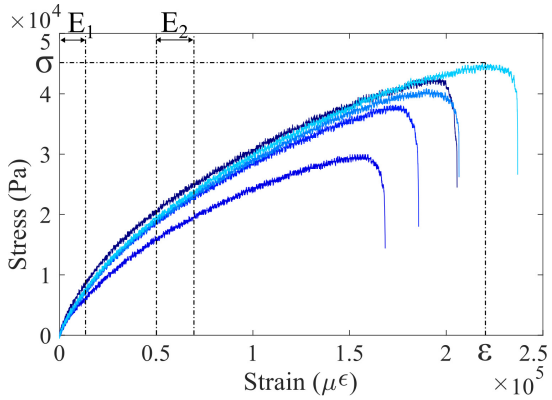

Fig. S2 Stress versus strain curve for alginate-poloxamer hydrogel with 1% flax fibre weight fraction, including definition of the related mechanical properties/engineering constants.

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2.2 Filament Fusion test

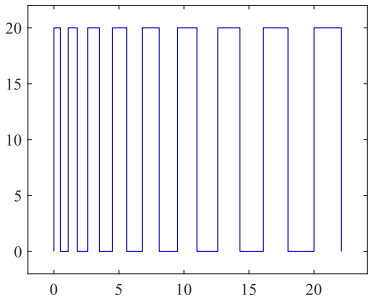

Fig. S3 Printing path for fusion filament test in mm.

2.3 Annulus scaffold

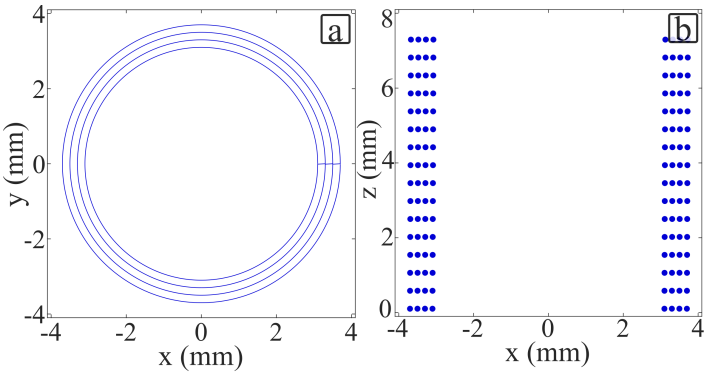

Fig. S4 Printing path to produce cylinder specimen. a): Top view; b): Side view.

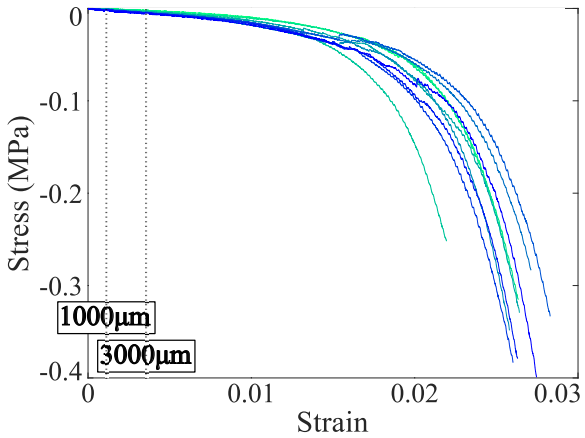

Fig. S5 Stress strain curve for compression test of the cylinder.

2.4 Rheology test

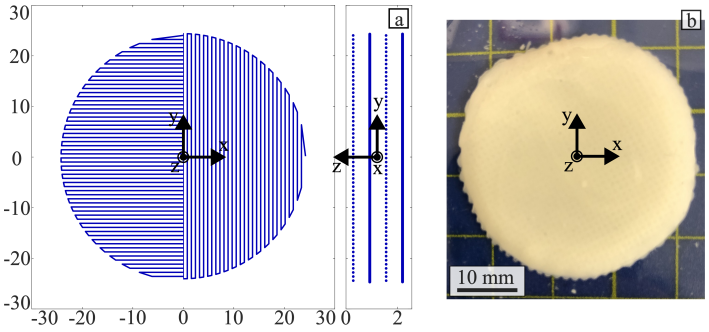

Fig. S6 Rheological specimen. a): Printing path in mm b): Printed specimens.

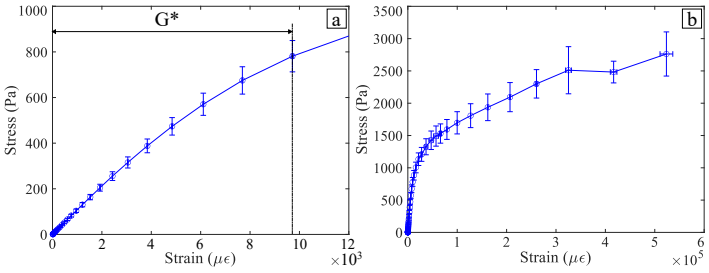

Fig. S7 Stress strain curve rheology for 1% of fibre weight fraction. a): Zoom on the stress range curve used to calculate the complex modulus. b): Full strain range.

2.5 Density and Coefficient of Moisture Expansion

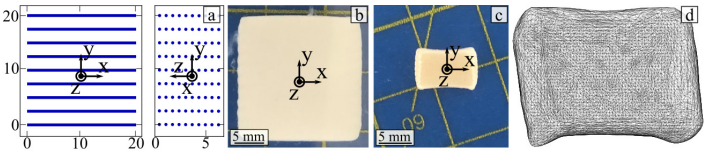

Fig. S8 Density and coefficient of moisture expansion measurement. a): Printing path in mm b): Wet specimen c): Dry specimen d): 3D scanner volume of dried specimen.

2.6 4D printing

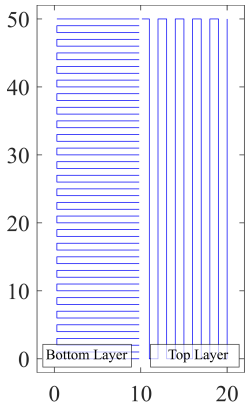

Fig. S9 4D printed path for [0°;90°] specimens in mm.

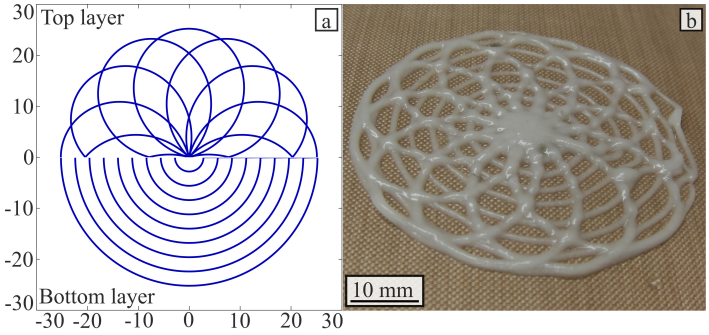

Fig. S10 4D printed rosette. a): Printing path in mm b): Printed and cross-linked rosette.