Supporting Information

Exploring Digital Image Correlation Technique for the Analysis of the Tensile Properties of All-Cellulose Composites

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Analysis of data using DIC approach

For each subset, the strain was calculated using a collection of data points. The noise and spatial discretization were filtered. The spacing (in pixels) of the data points are determined by the step size. If the filter size is *n*, and the step size is *m*, the total smoothing area is *n**m* pixels. This zone corresponds to the area where the deformation gradient is interpolated before being derived. For the analysis, a zero normalized sum of square difference correlation criterion is used. Moreover, to reach sub-pixel resolution an interpolation of the grey level is made using quintic 8-tap splines.

As shown by Candau et al [2], DIC analysis needs the evaluation of the influence of the main correlation parameters (subset, step and filter size) on the strain field. These parameters are determined within the gauge length area. The optimal parameters are selected when the deformation does not depend on *n*m*.

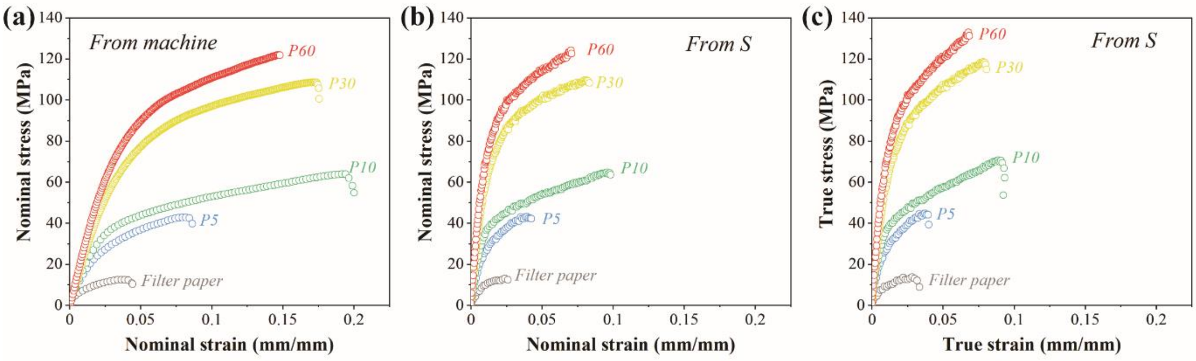

Figure S1.

The representative stress-strain curves derived from (a) nominal, machine approach and (b) nominal and (c) true stress-strain curves derived from local approach using stereovision (over surface S) for filter paper and ACCs.

Table S1. Mechanical properties of filter paper and the corresponding ACCs calculated from nominal (machine and local, stereovision over surface S) and true (local stereovision over surface S).

	Sample	**Tensile Strength (MPa)**	**Youngs' modulus (GPa)**	**Strain (%)**	**Toughness (MJ/m^3)**
Nominal (machine)	Filter paper	12.6 ± 0.1	0.75 ± 0.05	3.6 ± 0.4	0.34 ± 0.02
	P5	41.7 ± 1.8	1.46 ± 0.01	7.6 ± 0.7	2.3 ± 0.30
	P10	60.9 ± 2.7	1.69 ± 0.04	17.3 ± 1.9	8.2 ± 1.20
	F30	107.9 ± 1.1	2.5 ± 0.12	18.2 ± 1.6	15.2 ± 1.60
	F60	120.8 ± 3.0	2.7 ± 0.20	16.1 ± 1.3	14.4 ± 1.00
Nominal (local, over surface S)	Filter paper	13.2 ± 0.1	1.63 ± 0.03	2.7 ± 0.4	0.25 ± 0.04
	P5	42 ± 1.6	4.08 ± 0.07	3.7 ± 0.3	1.21 ± 0.10
	P10	61.6 ± 3.0	4.8 ± 0.04	8.9 ± 0.9	4.3 ± 0.50
	F30	109.5 ± 1.3	7.6 ± 0.60	9.1 ± 1.1	8.1 ± 1.10
	F60	122.7 ± 3.0	7.97 ± 0.60	7.5 ± 0.7	7.1 ± 0.40
True (local, over surface S)	Filter paper	13.6 ± 0.2	1.63 ± 0.03	2.6 ± 0.3	0.25 ± 0.04
	P5	43.2 ± 2.1	4.08 ± 0.07	3.6 ± 0.1	1.2 ± 0.10
	P10	65.1 ± 3.5	4.8 ± 0.04	8.3 ± 0.8	4.1 ± 0.50
	F30	117.3 ± 1.7	7.6 ± 0.6	8.8 ± 1.1	8 ± 1.10
	F60	130.5 ± 2.4	7.97 ± 0.6	7.3 ± 0.6	7 ± 0.40

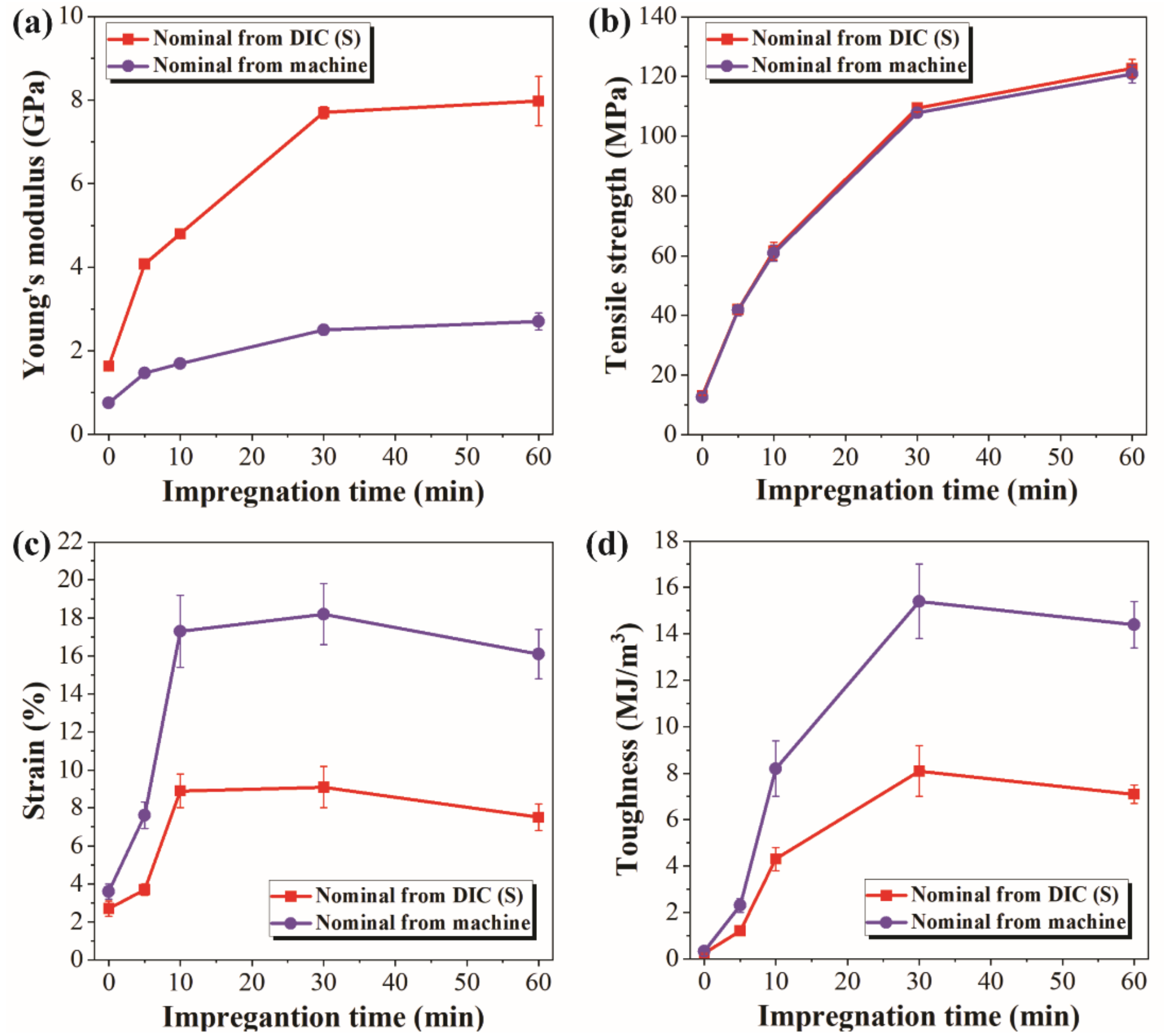

Figure S2.

The comparison of Young's modulus, strain at maximal stress, maximal tensile stress and toughness as a function of impregnation time derived from nominal stress-strain data of local approach (over surface S) and machine. The lines are given to guide the eye

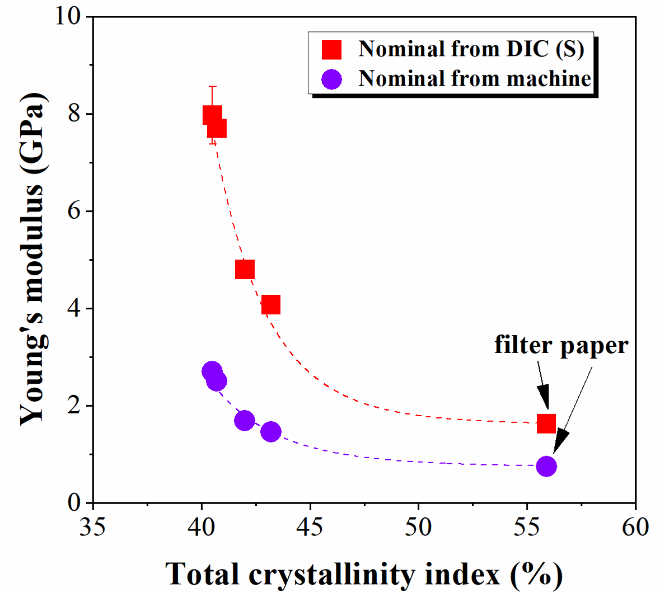

Figure S3.

Young's modulus as a function of crystallinity of the filter paper and ACCs as a function of density. When errors are not visible, they are within the size of the symbol. The lines are given to guide the eye

Table S2. List of tensile strength, specific strength and of the relative increase of specific strength, respectively, as compared to the starting filter paper for isotropic paper-based ACCs.

Sample	Density (g/cm^3)	Tensile strength (MPa)	Specific strength ($MPa/(g/cm^3)$)	Young's modulus (GPa)	Specific modulus ($GPa/(g/cm^3)$)	Ref.
P60	1.31	122.7	93.7	8.0	6.1	This work
120s	0.92	52.4	56.9	5.8	6.3	[1]

Reference

[1] Piltonen P, Hildebrandt NC, Westerlind B, Valkama JP, Tervahartiala T, Illikainen M. Green and efficient method for preparing all-cellulose composites with NaOH/urea solvent. *Composites Science and Technology* 2016, 135:153-8.

[2] Candau N, Pradille C, Bouvard JL, Billon N. On the use of a four-cameras stereovision system to characterize large 3D deformation in elastomers. *Polymer Testing* 2016, 56:314-20.