Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B.

Supporting information

"Anisotropic solid-state PLA foaming templated by crystal phase pre-oriented with 3D printing: Cell supporting structures with directional capillary transfer"

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1. FTIR estimation of the L and D content in PLA

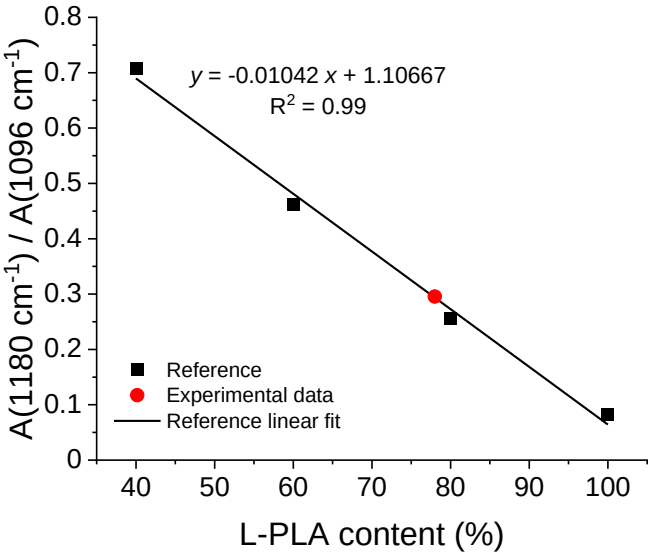

Fig. S1: Plot of the relative ratio of FTIR peaks at 1180 and 1096 cm^{-1} in the fingerprint region from the ref. 32 fitted with linear curve and used for the estimation of the D and L-PLA content in the PLA used throughout this study.

2. Wide angle X-ray scattering (WAXS)

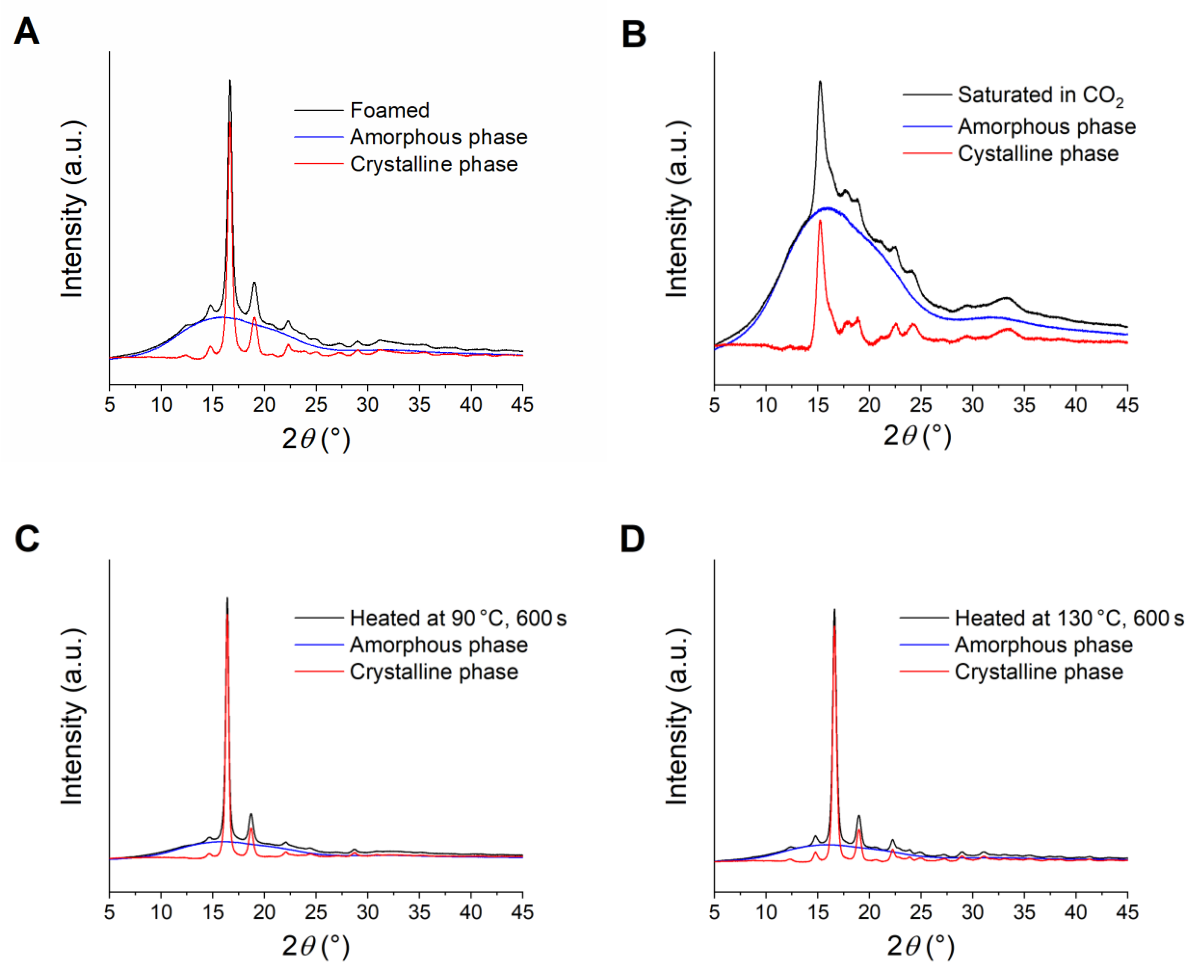

Fig. S2: WAXS diffractograms, amorphous reference, and signal of the crystalline phase for samples (A) foamed, (B) saturated with CO_2, and (C) heated at 90 °C and (D) at 130 °C.

Table S1: Overview of WAXS peaks and crystallinity.

Sample	$w_{c,\,WAXS}$ **(%)**		**WAXS peaks**						
Saturated in CO_2	22.3	***2θ***	15.22°	16.03°	17.60°	18.77°	22.56°	24.00°	21.11°
		d_{hkl}	0.582	0.552	0.504	0.472	0.394	0.370	0.421
		hkl	110	Unclear	Unclear	200	015	016	204
Heated at 90 °C	50.2	***2θ***	14.65°	16.40°	18.72°	22.07°	24.46°		
		d_{hkl}	0.604	0.540	0.474	0.402	0.364		
		hkl	011	110/200	203	015	Unclear		
Heated at 130 °C	44.8	***2θ***	12.34°	14.78°	16.61°	18.99°	22.23°	23.86°	24.94°
		d_{hkl}	0.717	0.599	0.533	0.467	0.400	0.373	0.357
		hkl	004/103	011	110/200	203	015	Unclear	206
Foamed	43.5	***2θ***	14.80°	16.65°	19.01°	22.28°			
		d_{hkl}	0.598	0.532	0.466	0.399			
		hkl	011	110/200	203	015			

2. Differential Scanning Calorimetry (DSC)

Table S2: Overview of the temperatures (T) and enthalpies (ΔH) established from the DSC curves at a heating rate of 10 K·min^{-1}. The subscripts *cc1*, *cc2*, *m*, and *c* relate to the first and second peak of cold crystallization, ultimate melting, and the actual crystallinity, respectively. The $w_{c,\,DSC}$ and $w_{c,\,XRD}$ represents the crystallinity obtained by DSC and WAXS, respectively.

*Related to $\Delta H_{0,\alpha'\text{-PLA}}$ = 68.2 J·g^{-1}.

	T_g (°C)	ΔH_{cc1} (J·g^{-1})	T_{cc} (°C)	ΔH_{cc2} (J·g^{-1})	T_{rc} (°C)	ΔH_m (J·g^{-1})	T_m (°C)	ΔH_c (J·g^{-1})	$w_{c,\,DSC}$ (%)	$w_{c,\,XRD}$ (%)
3D printed	62,2	–33.6	98.4	–2.0	154.8	36.4	168.8	0.8	0.9	-
Saturated	37,5	–6.4	128.3	–	–	32.4	168.8	26.0	27.9	22.3
90°C	64.2	–1.7	76.0	–0.2	153.1	37.4	167.3	35.9	56.6*	50.2
130°C	63.2	–0.1	76.1	–	–	42.3	168.6	42.2	45.4	44.8
Foamed	63.6	–	–	–	–	35.9	168.4	35.9	38.6	38.2

Table S3: Overview of the melting temperatures (T_m) established from the DSC curves at a heating rate of 1 K·min^{-1}.

	$T_{m,1}$ (°C)	$T_{m,2}$ (J·g^{-1})
3D printed	165.4	170.8
Saturated	170.2	–
90°C	169.6	–
130°C	165.5	171.2
Foamed	169.9	–

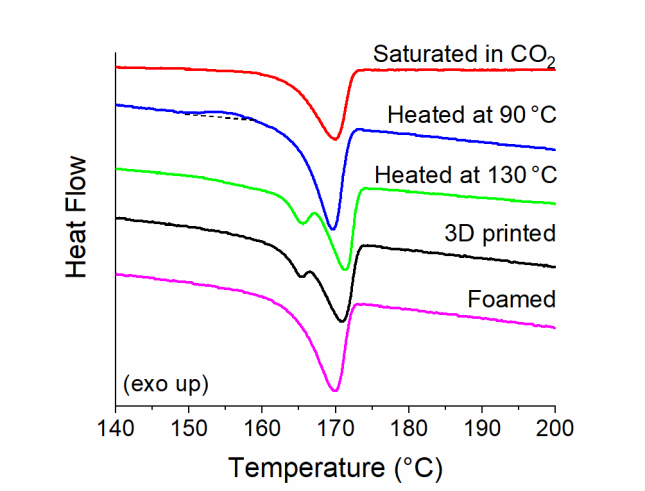

Fig. S3: DSC curves of the melting for 3D printed (black), CO_2 saturated (red), and heated at 90 (blue) and 130 °C (green) samples recorded at a heating rate of 1 K·min^{-1}.

3. Additional SEM images

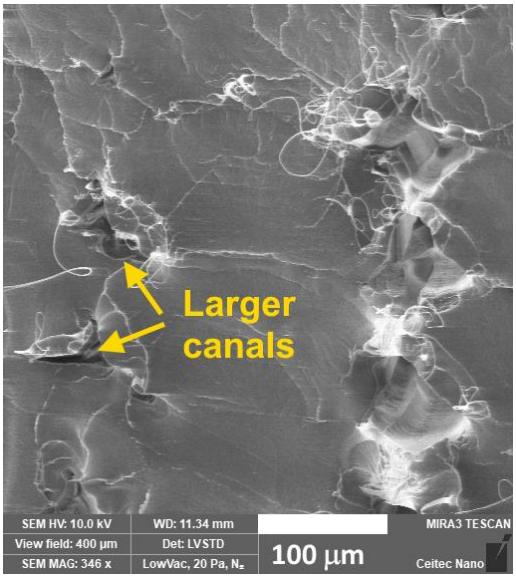

Fig. S4: SEM image detail of the larger canals in the cross-section direction.

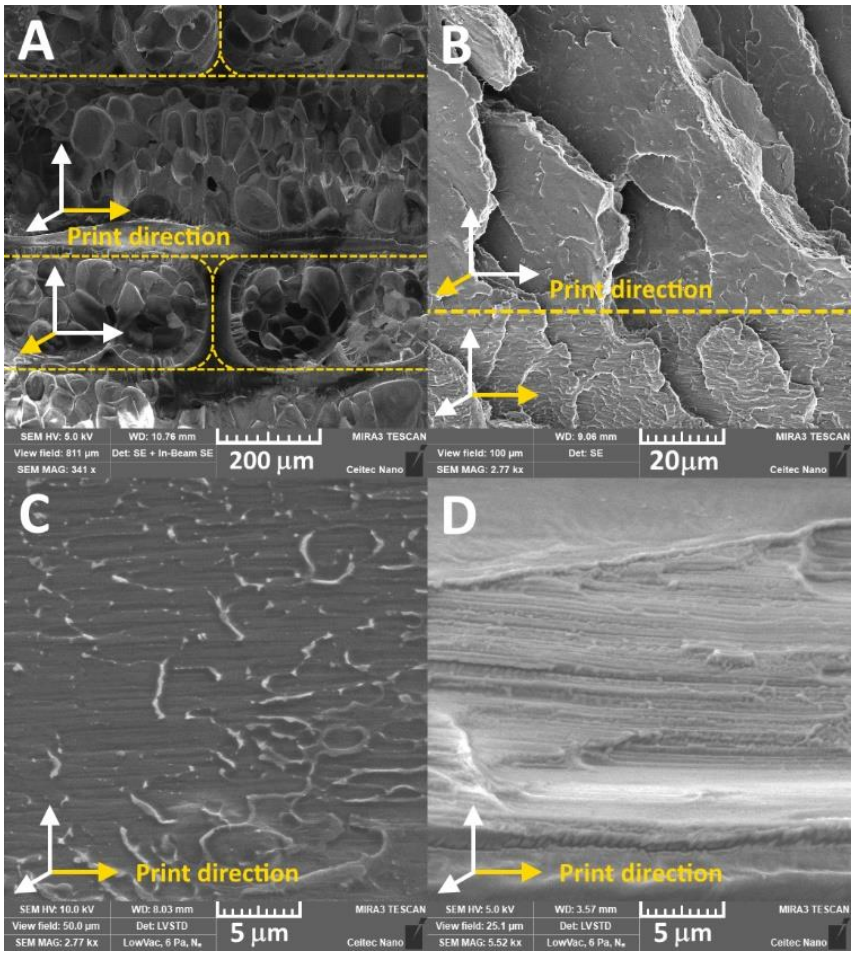

Fig. S5: SEM images of (A) 3D printed PMMA foamed at 130 °C, (B) 3D printed PLA (C) 3D printed PLA heated at 130 °C, and (D) PLA foamed without external confinement. The yellow arrow and dashed line indicate the print direction and print layer boundaries, respectively.

4. Stress-strain curves

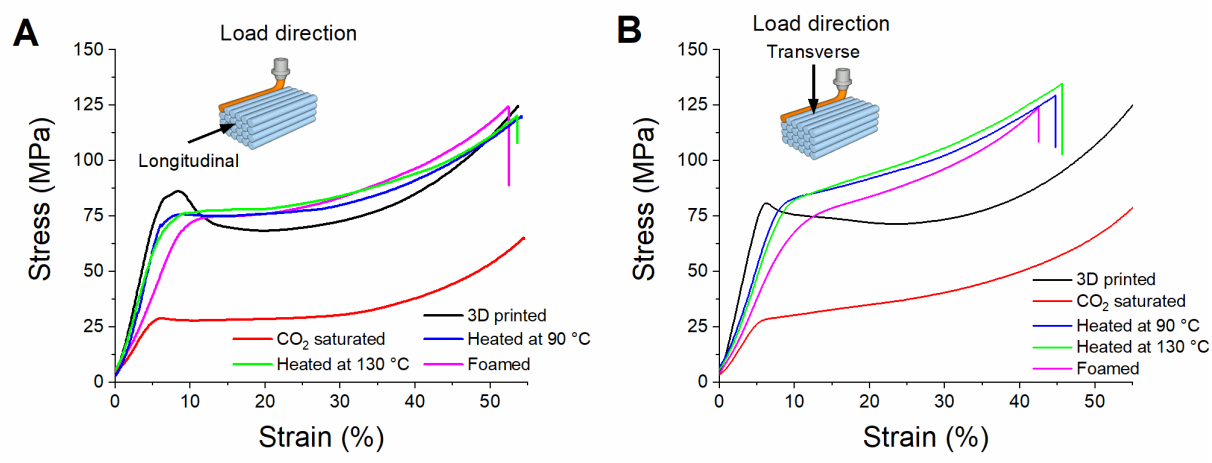

Fig. S6: Representative stress-strain curves under compression load in (A) longitudinal and (B) transverse direction respective to the print orientation.