

Supplementary Information for:

Effect of biobased SiO₂ on the morphological, thermal, mechanical, rheological and permeability properties of PLLA/PEG/SiO₂ biocomposites

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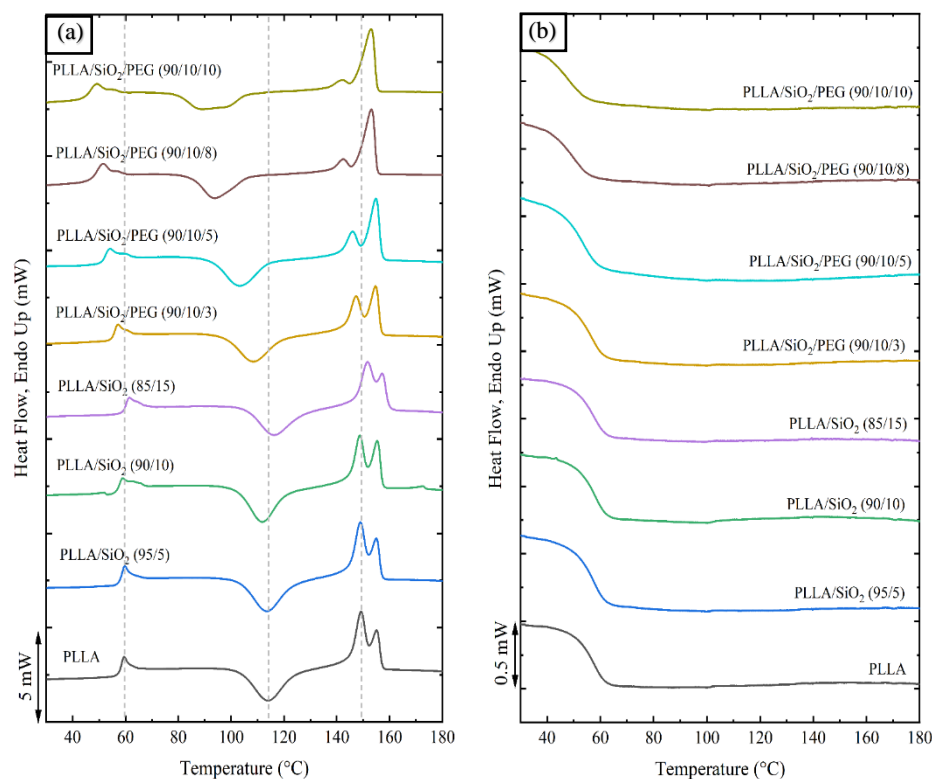


Figure S1: DSC thermograms of (a) first heating and (b) cooling step for PLLA, PLLA/SiO₂ and PLLA/SiO₂/PEG composites.

Table S1. Avrami fitting parameters (n , K , and $\tau_{theo}^{1/2}$) and their correlation coefficient (R^2). The experimental value of $\tau^{1/2}$ is given for comparison purposes. The conversion range used was the same in each case (5–20%).

Sample	T (°C)	n (-)	K (min ⁻ⁿ)	$\tau_{theo}^{1/2}$ (min)	$\tau_{exp}^{1/2}$ (min)	R^2
PLLA	91	3.27	3.42E-04	10.3	9.87	0.9992
	93	3.32	9.76E-04	7.23	7.20	0.9999
	95	3.68	8.32E-04	6.22	6.29	1.0000
	97	4.00	5.13E-04	6.06	6.18	1.0000
	100	3.68	7.75E-04	6.14	6.33	1.0000
	103	3.56	1.56E-03	5.56	5.76	0.9999
PLLA/SiO ₂ (95/5)	90	3.61	1.34E-04	10.7	10.5	0.9999
	91	3.64	1.19E-04	10.8	10.6	0.9996
	93	3.77	1.87E-04	8.83	8.82	0.9998
	95	3.87	2.51E-04	7.73	7.81	0.9999
	97	3.78	5.05E-04	6.76	6.93	1.0000
	100	3.61	1.29E-03	5.70	5.87	1.0000
PLLA/SiO ₂ (90/10)	95	3.75	3.21E-04	7.76	7.74	0.9998
	97	3.59	7.08E-04	6.81	6.76	0.9997
	100	3.45	2.05E-03	5.41	5.39	0.9998
	103	3.32	5.28E-03	4.40	4.36	0.9998
	105	3.32	4.86E-03	4.46	4.42	0.9998
	107	3.28	1.07E-02	3.57	3.53	0.9998
PLLA/SiO ₂ (85/15)	91	4.16	8.18E-06	15.3	15.7	1.0000
	93	4.21	1.28E-05	13.4	14.0	0.9999
	95	3.74	7.17E-05	11.6	12.0	1.0000
	97	3.48	1.97E-04	10.4	10.7	1.0000
	100	3.24	7.10E-04	8.37	8.51	1.0000
	103	3.02	1.91E-03	7.06	7.11	1.0000
PLLA/SiO ₂ /PEG (90/10/3)	95	3.60	1.26E-03	5.77	5.89	1.0000
	97	3.49	2.57E-03	4.97	5.24	1.0000
	100	3.37	7.34E-03	3.86	4.13	1.0000
	103	3.26	1.67E-02	3.13	3.37	1.0000
	105	3.23	2.47E-02	2.81	3.01	1.0000
	107	3.17	3.68E-02	2.52	2.69	1.0000

PLLA/SiO ₂ /PEG (90/10/5)	86	3.08	1.18E-03	7.90	7.63	0.9996
	88	3.13	2.52E-03	6.02	5.80	0.9994
	90	3.15	6.15E-03	4.48	4.29	0.9993
	93	3.08	1.27E-02	3.66	3.54	0.9993
	95	3.06	2.54E-02	2.95	2.85	0.9994
	97	3.04	4.58E-02	2.44	2.37	0.9995
PLLA/SiO ₂ /PEG (90/10/8)	84	3.06	3.30E-03	5.74	5.29	0.9990
	86	3.15	5.87E-03	4.56	4.24	0.9990
	88	3.21	1.19E-02	3.54	3.34	0.9992
	90	3.19	2.55E-02	2.82	2.66	0.9992
	91	3.24	3.59E-02	2.49	2.36	0.9994
	95	2.98	1.43E-01	1.70	1.59	0.9991
PLLA/SiO ₂ /PEG (90/10/10)	78	3.04	6.80E-04	9.78	9.41	0.9993
	80	3.05	1.52E-03	7.44	7.13	0.9991
	82	3.16	2.78E-03	5.72	5.55	0.9995
	84	3.20	5.78E-03	4.47	4.35	0.9996
	86	3.24	1.30E-02	3.41	3.34	0.9998
	88	3.30	2.64E-02	2.69	2.65	0.9998

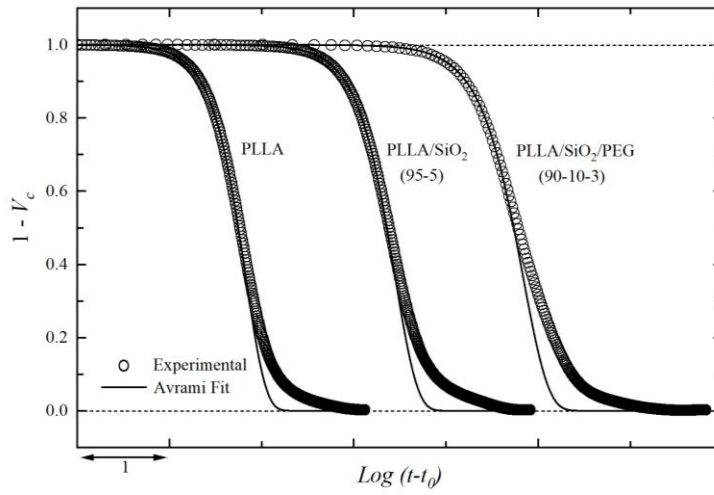


Figure S2. Variation of $1 - V_c$ (volumetric relative amorphous content) as a function of $\log(t - t_0)$. The lines represent fitting to the Avrami model (Eq. 3) with the parameters of Table 6. The crystallization temperatures were 97, 100, and 107 °C for PLLA, PLLA/SiO₂ (95-5), and PLLA/SiO₂/PEG (90-10-3), respectively.

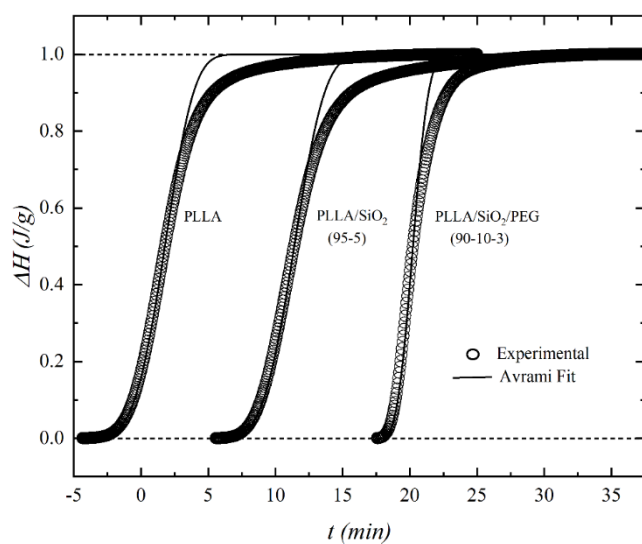


Figure S3. Variation of the enthalpy of crystallization (ΔH_c) as a function of time (t) for PLLA, PLLA/SiO₂ (95-5), and PLLA/SiO₂/PEG (90-10-3).

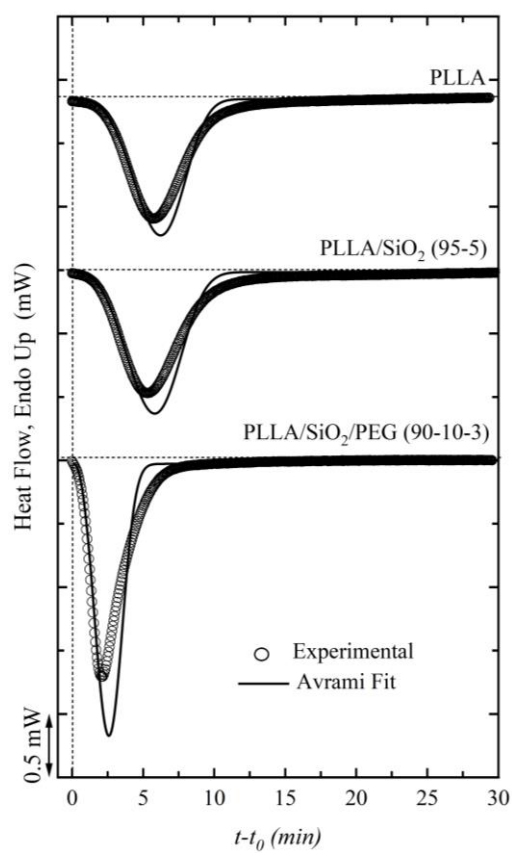


Figure S4. Experimental DSC isotherms and simulated DSC curves by the Avrami equation for PLLA, PLLA/SiO₂ (95-5), and PLLA/SiO₂/PEG (90-10-3). The crystallization temperatures were 97, 100, and 107 °C for PLLA, PLLA/SiO₂ (95-5), and PLLA/SiO₂/PEG (90-10-3), respectively.

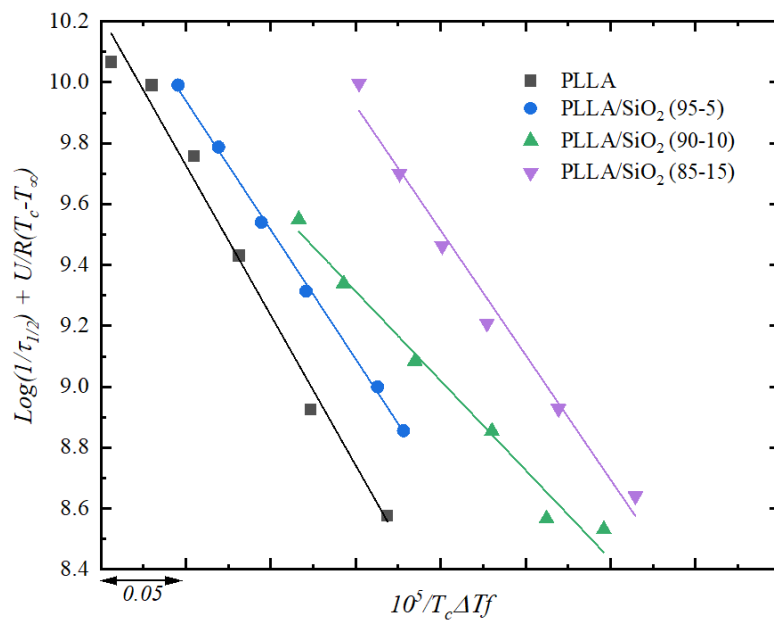


Figure S5. Plots of $\ln(1/t_{1/2}) + U^*/R(T_c - T_\infty)$ as a function of $(1/T_c \Delta T f)$ for PLLA, PLLA/SiO₂ (95-5), PLLA/SiO₂ (90-10), and PLLA/SiO₂ (85-15).

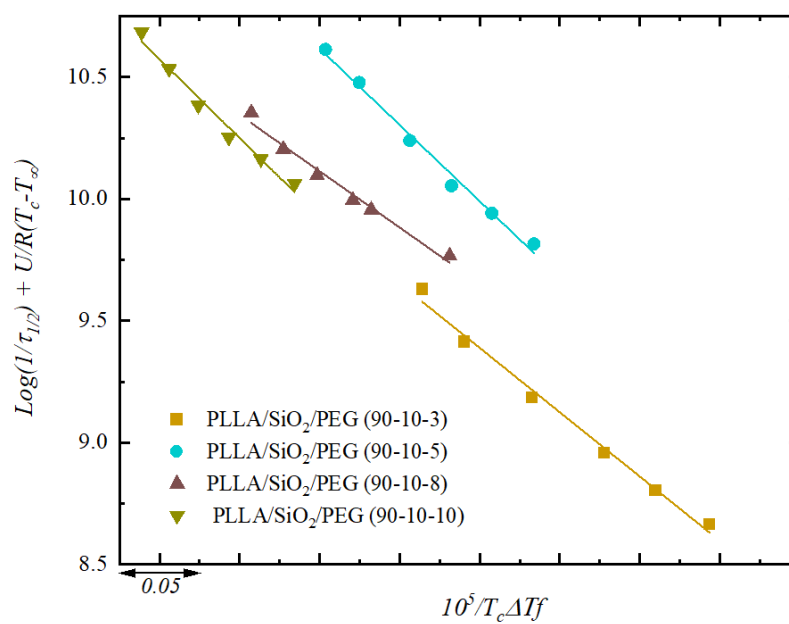


Figure S6. Plots of $\ln(1/t_{1/2}) + U(*)/R(T_c - T_\infty)$ as a function of $(1/T_c\Delta Tf)$ for PLLA/SiO₂/PEG composites.