Hybrid Green Bionanocomposites of Bio-based Poly(butylene succinate) Reinforced with Pyrolyzed Perennial Grass Microparticles and Graphene Nanoplatelets

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Figure S1: Zero shear viscosity (left) and melt flow index (right). Where (A) BioPBS, (B) BioPBS/BC (90/10), (C) BioPBS/BC (85/15), (D) BioPBS/BC (80/20), (E) BioPBS/BC (75/25), (F-G) BioPBS/BC/GnP (MB) (75/24/1) and (75/20/5), respectively, and (H-I) BioPBS/BC/GnP (DC) (75/24/1) and (75/20/5), respectively.

Table S1: Thermal data of the neat polymer and composite samples.

Table S2: 2^2 analysis of variance of impact strength on GnP content and processing methods, alpha - 0.05.

Table S3: 2^2 analysis of variance of tensile strength on of GnP content and processing methods, alpha - 0.05.

Table S4: Two-Sample t test, assuming unequal variances, of CLTE and HDT measurements, alpha - 0.05
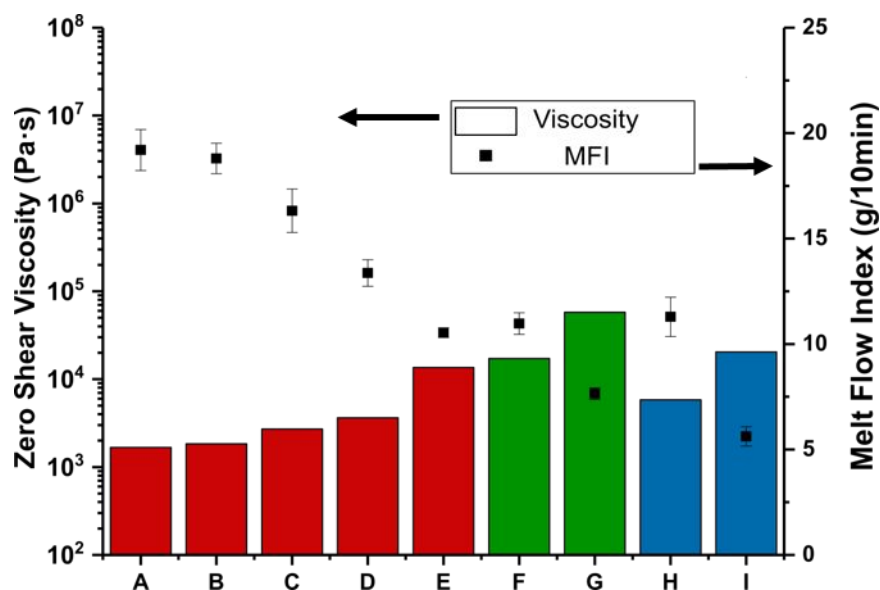
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Table S1. Thermal data of the neat polymer and composite samples.

Samples	T_m (°C)	ΔH_m (J/g)	T_c (°C)	ΔH_c (J/g)	Crystallinity (%)
BioPBS	115.7±0.03	70.5 ± 1.63	91.2 ± 0.05	69.2 ± 0.43	34.60
BioPBS/10BC	115.2±0.16	57.5 ± 0.44	89.4 ± 0.05	62.8 ± 0.24	28.26
BioPBS/15BC	115.8±0.01	50.9 ± 0.39	89.8 ± 0.20	55.5 ± 0.76	23.61
BioPBS/20BC	115.5±0.25	48.1 ± 0.54	88.4± 0.22	52.1± 0.87	20.83
BioPBS/25BC	115.6±0.40	44.0 ± 0.08	87.9 ± 0.29	48.6 ± 1.0	18.23
BioPBS/24BC/1GnP - master batch -	114.8±0.57	54.3 ± 3.27	96.4 ± 0.11	51.1 ±1.1	19.15
BioPBS/20BC/5GnP - master batch -	114.0±0.29	54.3 ± 1.53	98.8 ± 0.12	49.5 ± 0.5	18.56
BioPBS/24BC/1GnP - direct -	114.9±0.04	51.2 ± 0.08	95.9 ± 0.11	50.6 ± 0.76	18.98
BioPBS/20BC/5GnP - direct -	115.3±0.85	52.4 ± 0.55	98.2 ± 0.14	51.4 ± 1.3	19.27
BioPBS/25GnP - master batch -	114.6±1.00	51.9 ± 0.47	99.3 ± 0.33	52.0 ± 0.24	19.51

Table S2: 2^2 analysis of variance of impact strength on GnP content and processing methods, alpha - 0.05.

2^2 ANOVA with replicates - Impact Strength

Source of Variation	SS	df	MS	F	P-value	F crit
Process method	415.9637	1	415.9637	255.9819	2.33E-07	5.317655
Amount of GnP	123.7198	1	123.7198	76.13656	2.33E-05	5.317655
Interaction	70.15585	1	70.15585	43.17356	0.000175	5.317655
Within	12.99978	8	1.624973			
Total	622.8391	11				

Table S3: 2^2 analysis of variance of tensile strength on of GnP content and processing methods, alpha - 0.05.

2^2 ANOVA with replicates - Tensile Strength

Source of Variation	SS	df	MS	F	P-value	F crit
Process method	11.1005	1	11.1005	11.17031	0.004135	4.493998
Amount of GnP	11.7045	1	11.7045	11.77811	0.003422	4.493998
Interaction	0.0405	1	0.0405	0.040755	0.842557	4.493998
Within	15.9	16	0.99375			
Total	38.7455	19				

Table S4: Two-Sample t test, assuming unequal variances, of CLTE and HDT measurements, alpha - 0.05.

	BioPBS/ 10BC	BioPBS/ 15BC	BioPBS/ 20BC	BioPBS/ 25BC	BioPBS/ 24BC/ 1GnP (MB)	BioPBS/ 20BC/ 5GnP (MB)	BioPBS/ 24BC/ 1GnP (DC)	BioPBS/ 20BC/ 5GnP (DC)
CLTE t stat	-0.147	9.66	4.60	8.71	10.4	4.12	9.85	9.88
CLTE t critical	12.7	12.7	12.7	4.30	12.7	12.7	12.7	12.7
HDT t stat	-1.97	-6.21	-6.77	-12.6	-8.88	-7.46	-7.57	-8.98
HDT t critical	4.30	12.7	12.7	12.7	12.7	12.7	4.30	12.7