Supporting Information

Polyphenol-Based Fire-Resistant Coatings: A Bio-Inspired Solution for Forest Fire Prevention

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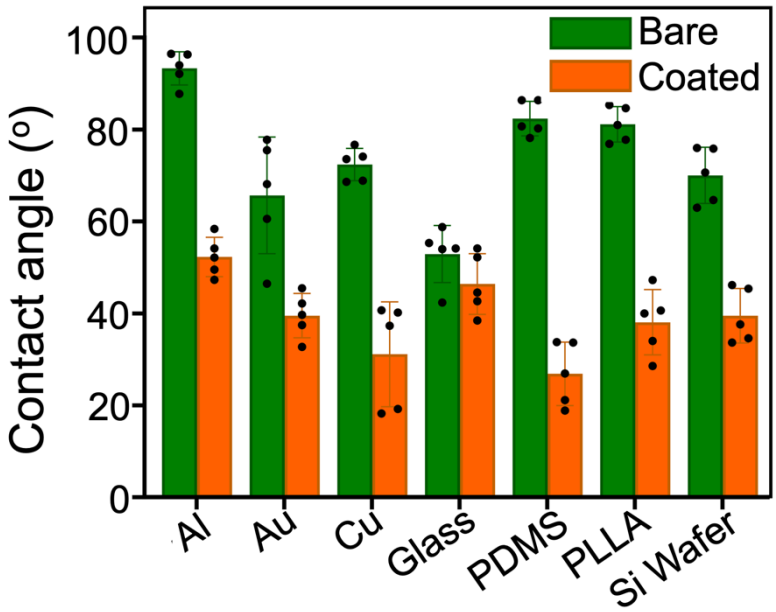

Figure S1. Contact angle measurements of various substrates—aluminum (Al), gold (Au), copper (Cu), glass, polydimethylsiloxane (PDMS), poly(L-lactic acid) (PLLA), and silicon wafers—before and after coating them with PG–PEI. Each measurement involved a sample size of n = 5.

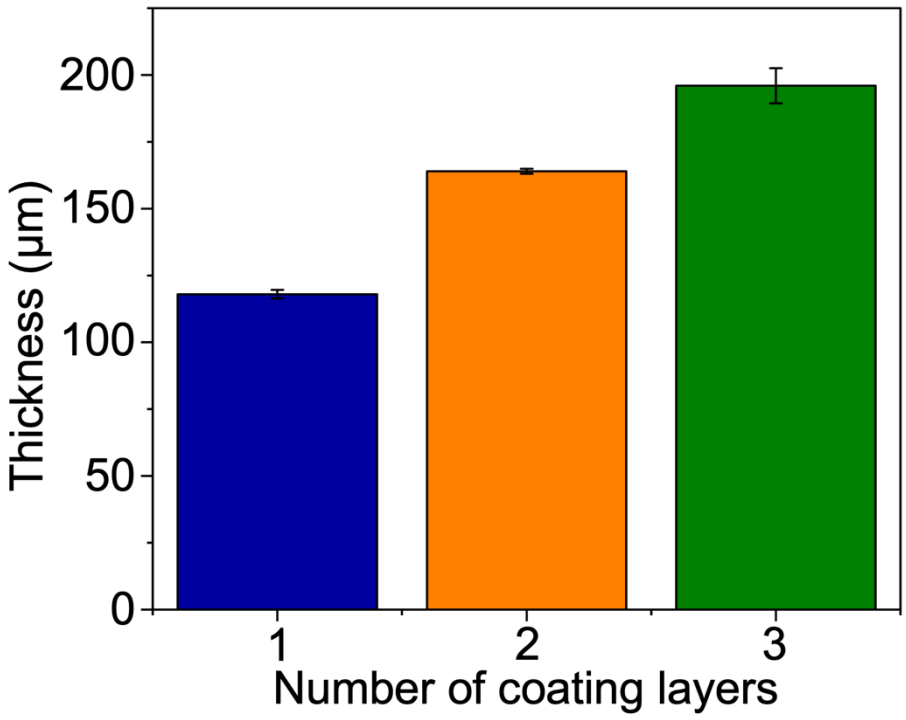

Figure S2. Coating thickness for one-, two-, and three-layer PG-PEI coatings.

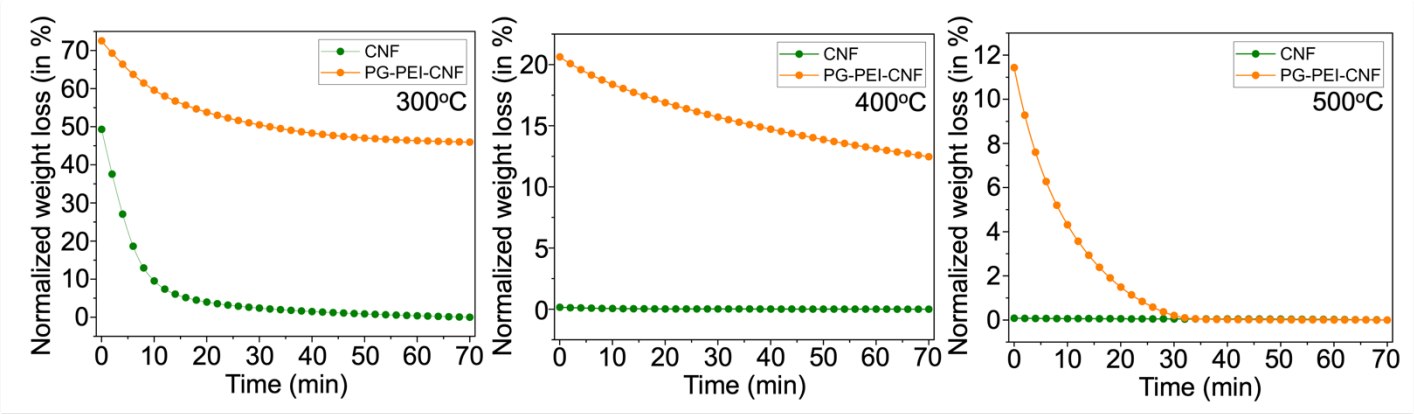

Figure S3. TGA results of cellulose nanofiber (CNF) and PG-PEI-CNF at constant temperatures 300 °C, 400 °C, and 500 °C.

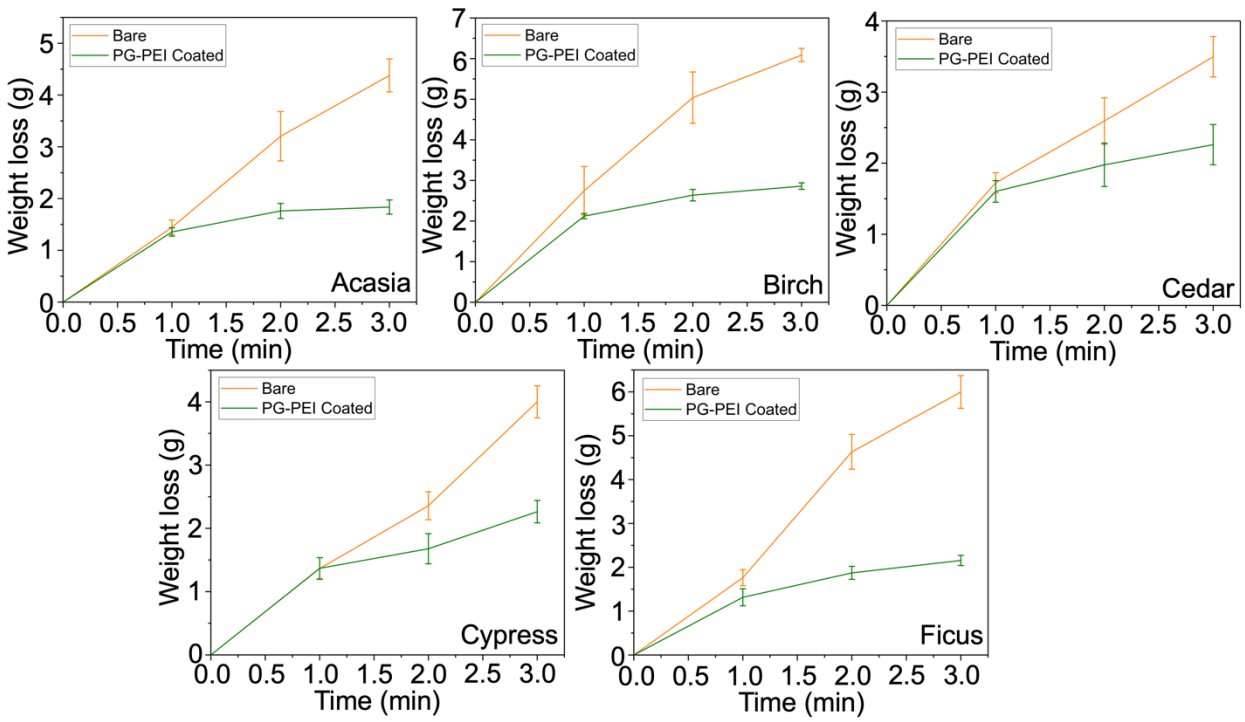

Figure S4. Fire-resistance performance of PG–PEI–coated and bare wood samples from various species (acacia, birch, cedar, cypress, and ficus).

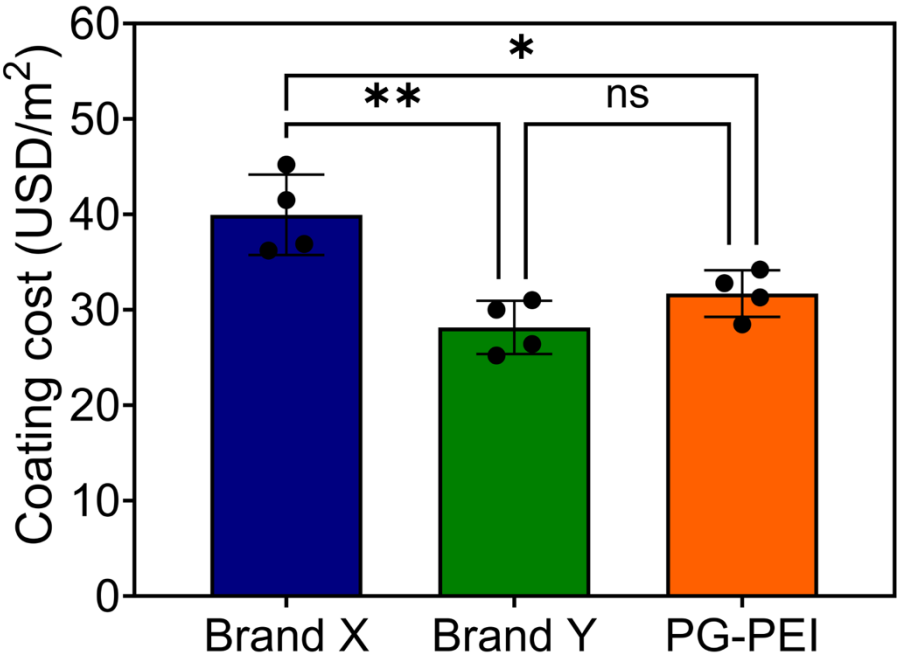

Figure S5. Cost evaluation of commercially available fire-retardant coatings (Brand X, and Brand Y), and PG-PEI coating.

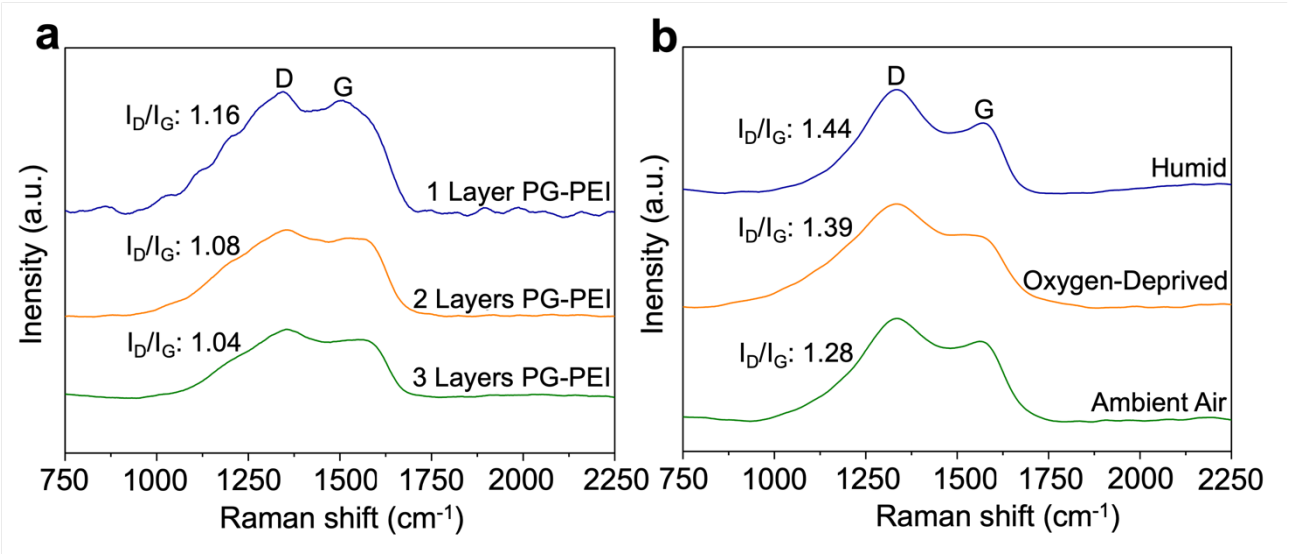

Figure S6. (A) Raman spectra of burned PG-PEI-coated wood samples with one, two, and three coating layers, along with the corresponding ID/IG ratios. (B) Raman spectra of burned PG-PEI-coated wood samples at different burning environments such as ambient air, oxygen-deprived, and humid environments, along with the corresponding ID/IG ratio derived from the Raman shift.

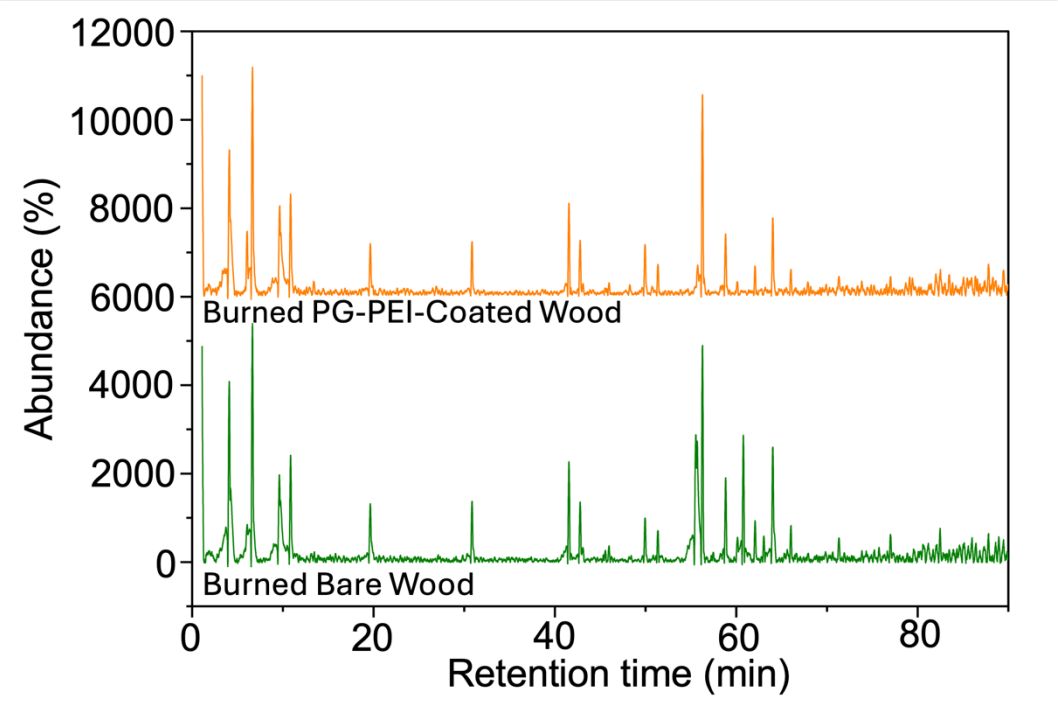

Figure S7. Comparison of GC chromatograms from burned bare wood and burned PG-PEI–coated wood.

Sample	Bare	Brand X	Brand Y	PG-PEI
Aluminum	N.D	0.135 ± 0.0038	N.D	N.D
Iron	N.D	0.076 ± 0.0081	N.D	N.D
Manganese	0.061 ± 0.0265	0.213 ± 0.0476	0.0145 ± 0.0085	N.D
Phosphorus	N.D	452 ± 49.9047	2.03 ± 0.3273	0.097 ± 0.0002
Arsenic	N.D	N.D	N.D	N.D
Cadmium	N.D	N.D	N.D	N.D
Cobalt	N.D	N.D	N.D	N.D
Copper	N.D	N.D	N.D	N.D
Molybdenum	N.D	N.D	N.D	N.D
Nickel	N.D	N.D	N.D	N.D
Titanium	N.D	N.D	N.D	N.D
Vanadium	N.D	N.D	N.D	N.D
Zirconium	N.D	N.D	N.D	N.D

Table S1. ICP-OES results for extracts from bare, Brand X, Brand Y, and PG-PEI coatings. Values are given in parts per million (ppm). N.D. indicates “not detected” or a concentration below 0.005 ppm.