Supporting information for

Borate chemistry inspired by cell walls converts soy protein into high-strength, antibacterial, flame-retardant adhesive

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Synthesis of water-soluble HBPE

We synthesized HBPE according to previously reported methods.[1-2] First, glycerol (46 g, 0.5 mol) and maleic anhydride (49 g, 0.5 mol) were continuously stirred at 75 °C for 1 h under a nitrogen (N_2) atmosphere. Pentaerythritol (0.454 g, 0.005 mol) was added and then reacted with the residual maleic anhydride by heating the mixture at 100 °C for 2 h, 120 °C for 2 h, and then 140 °C for 4 h. After the polymerization reaction was complete, the HBPE was purified by column chromatography using silica gel as the fixed phase and ethanol as the mobile phase.

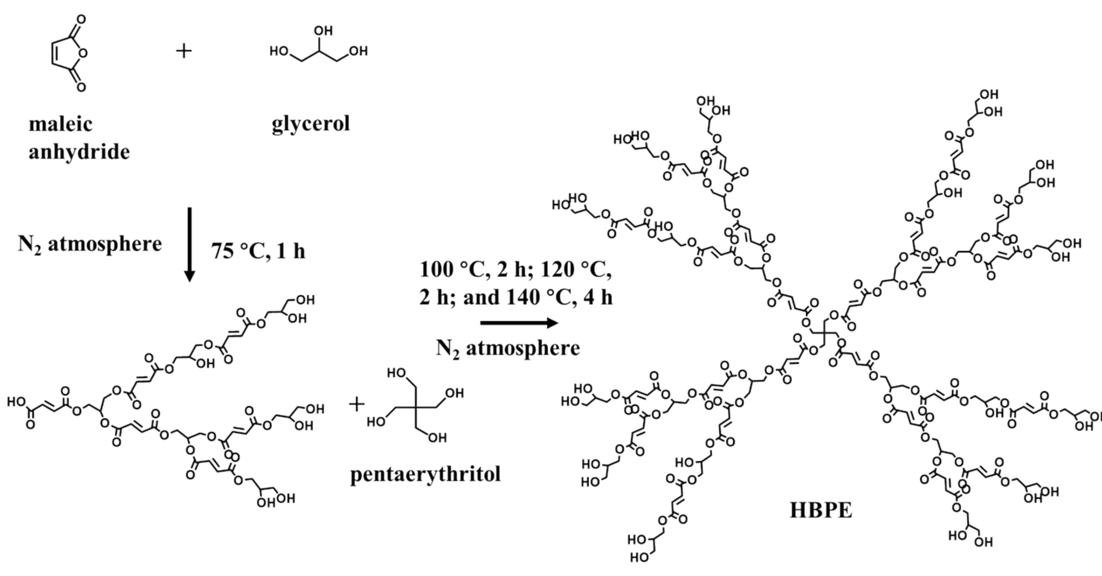

Figure S1. The synthesis of the HBPE

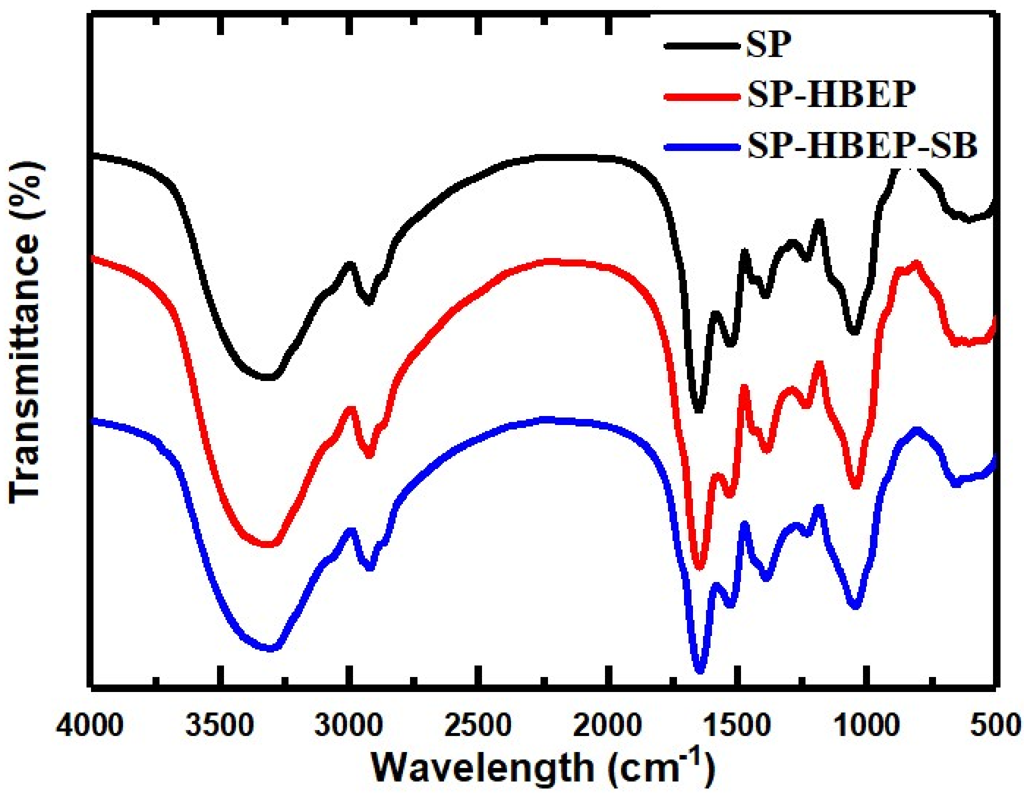

Figure S2. FTIR spectra of SP, SP-HBPE, and SP-HBPE-SB adhesives.

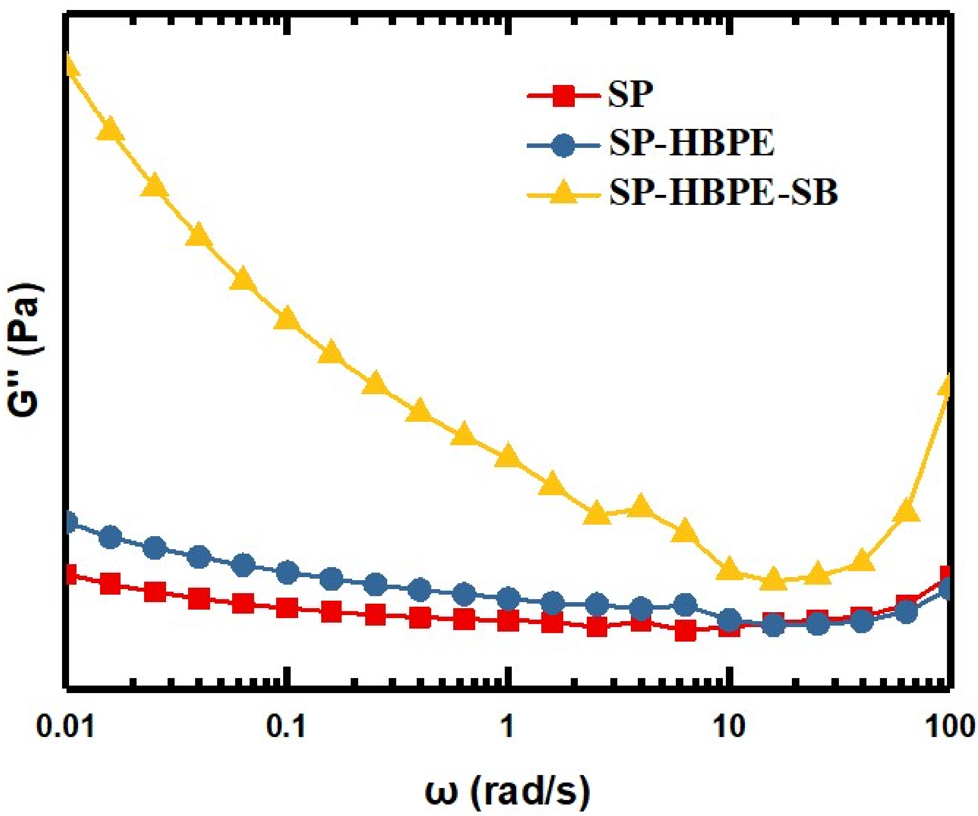

Figure S3. Loss modulus (G'') of SP, SP-HBPE, and SP-HBPE-SB adhesives.

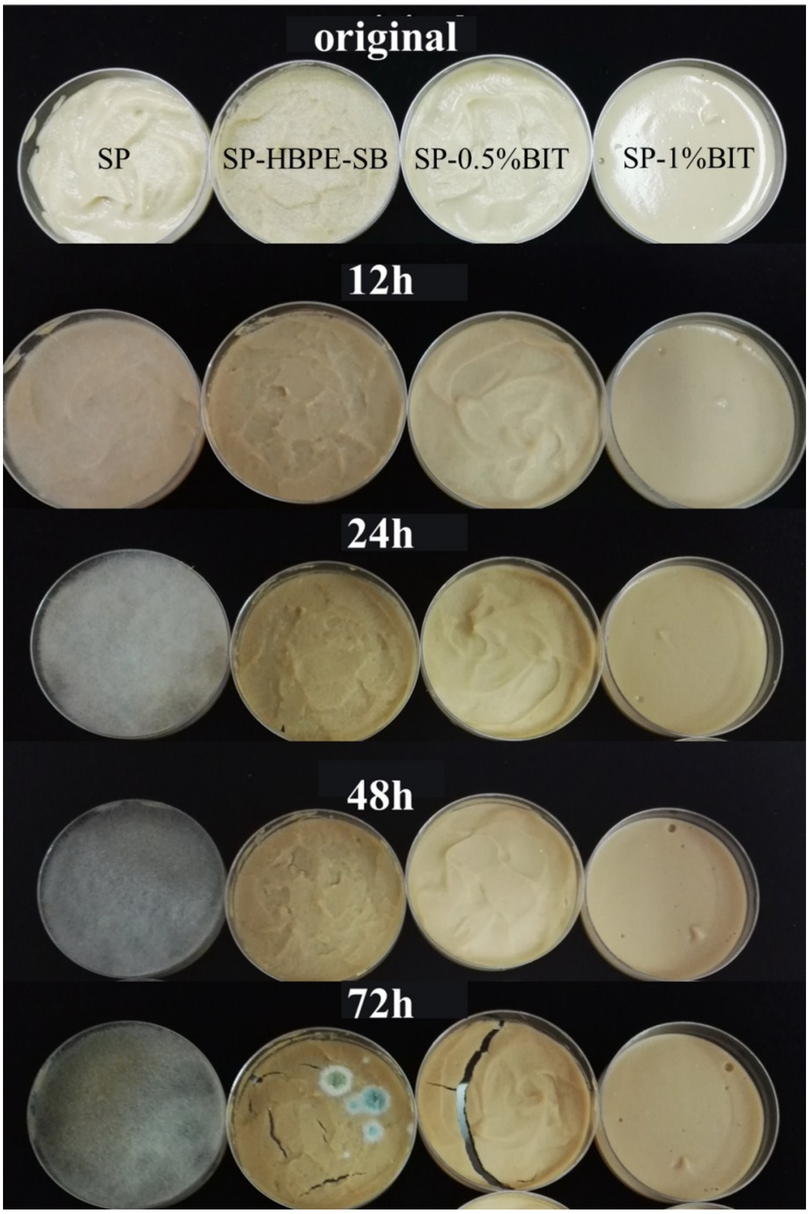

Figure S4. Photographs of SP, SP-HBPE-SB, SP-0.05%BIT, and SP-1%BIT adhesives before and after storage at 40 °C and 100% relative humidity for 72 h, respectively (BIT= 1,2-Benzisothiazol-3(2H)-one).

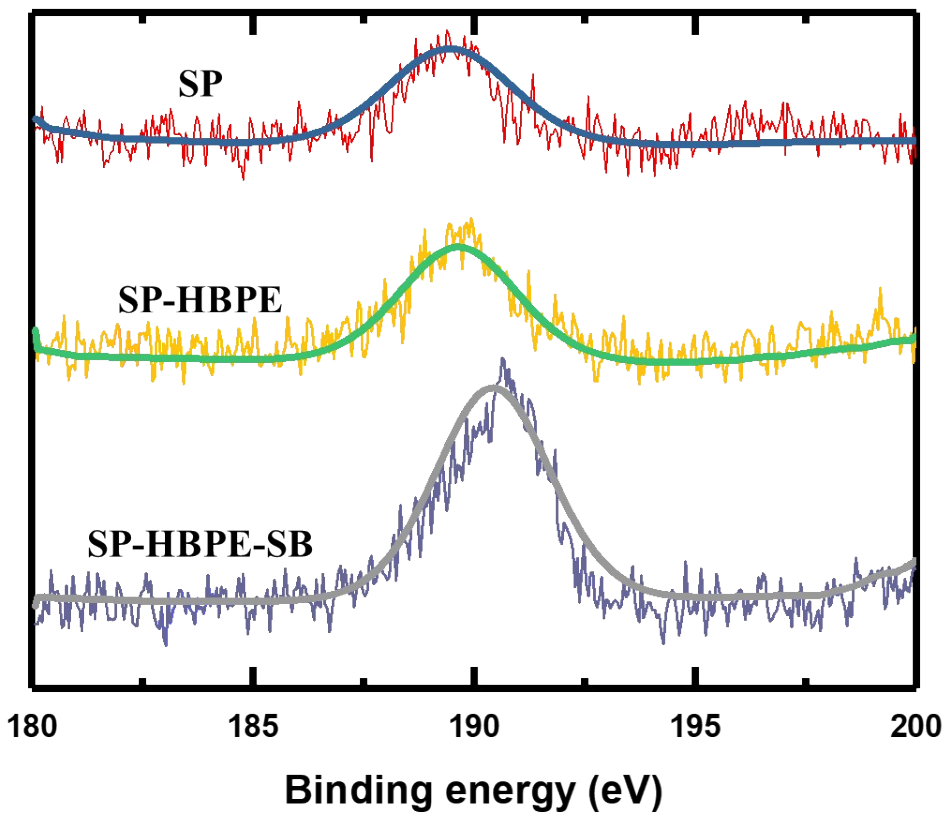

Figure S5. B 1s peak of the SP, SP-HBPE, and SP-HBPE-SB adhesives.

Table S1. The characteristics of different adhesives.

Types	Additive	Strength	References
Soy protein	Ascorbic acid	1.0 MPa [a]	[3]
Soy protein	Hyperbranched aminated polysaccharide and triglycidylamine	1.07 MPa [b]	[4]
Soy protein	Pickering emulsion and nanocrystals	1.21 MPa [b]	[5]
Soy protein	2-octen-1-ylsuccinic anhydride	3.2 MPa [a]	[6]
Soy protein	Montmorillonite and polyisocyanate	0.64 MPa [c]	[7]
Soy protein	Sorghum lignin	3.32 MPa [a]	[8]
Soy protein	Aspergillus niger	1.45 MPa [b]	[9]
Soy protein	Hyperbranched polysiloxane	1.45 MPa [b]	[10]
Tannin	Soy protein	1.03 MPa [b]	[11]
Soy protein	Tannin and poly(ethyleneimine)	1.05 MPa [b]	[12]
Lignin	Glycerol diglycidyl ether	2.2 MPa [a]	[13]
Phenolic resin	Bioethanol fermentation residues	1.07 MPa [b]	[14]
Starch	Acetylation	0.12 MPa [a]	[15]

[a] ASTM Standard Method D2339-98, [b] China National Standard GB/T 17657, [c] JIS K6806-2003.

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