§ Supporting Information §

Ionic liquid (1-ethyl-3-methylimidazolium acetate) plasticization of chitosan-based bionanocomposites

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1 Tables

Table S1. Bulk resistance (R_b) and ionic conductivity (σ_{dc}) calculated from the Nyquist plots of impedance, and real relative permittivity (ε'_r) at 1 kHz, of the different biopolymer and bionanocomposite films at RT.

Sample	R_b (Ω)	σ_{dc} (S·m^{-1})	ε'_r at 1 kHz
AE2-F	(2.05±0.48)×10^4	(7.70±1.93)×10^5	236±55
AE2/GO-F	(3.27±0.24)×10^4	(4.48±0.32)×10^5	134±23
AE2/rGO-F	(3.70±0.66)×10^4	(4.16±0.68)×10^5	84±14
AE4-F	(1.24±0.49)×10^4	(13.33±4.26)×10^5	365±115
AE4/GO-F	(0.82±0.33)×10^4	(17.77±0.72)×10^5	432±49
AE4/rGO-F	(1.70±0.67)×10^4	(9.59±3.05)×10^5	181±65
BE2-F	(2.42±0.33)×10^4	(5.98±0.76)×10^5	157±25
BE2/GO-F	(2.53±0.65)×10^4	(5.89±1.73)×10^5	117±43
BE2/rGO-F	(3.01±0.70)×10^4	(4.44±1.23)×10^5	104±29
BE4-F	(2.09±0.89)×10^4	(7.30±2.91)×10^5	249±99
BE4/GO-F	(1.36±0.53)×10^4	(10.40±2.91)×10^5	380±130
BE4/rGO-F	(3.72±0.77)×10^4	(3.70±0.69)×10^5	82±33

2 Figures

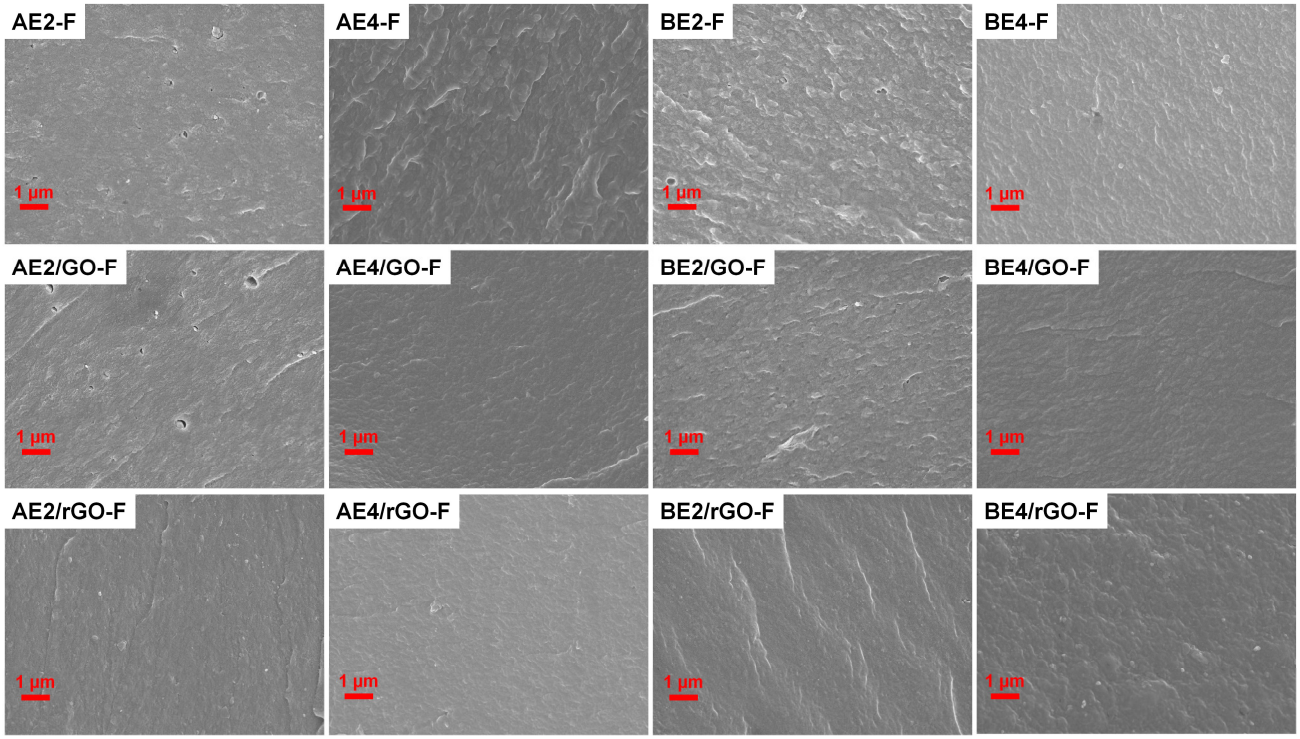

Figure S1. SEM images of cryo-fractured surfaces of the different biopolymer and bionanocomposite films (magnification: 10k×).

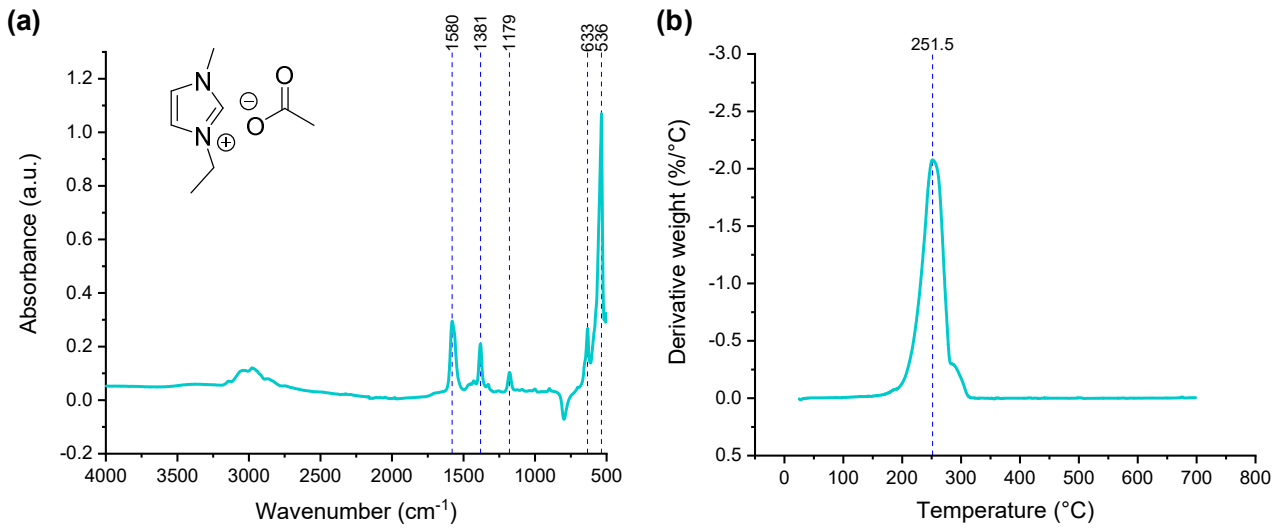

Figure S2. a) Chemical structure and FTIR spectrum and b) derivative-weight profile of 1-ethyl-3-methylimidazolium acetate.

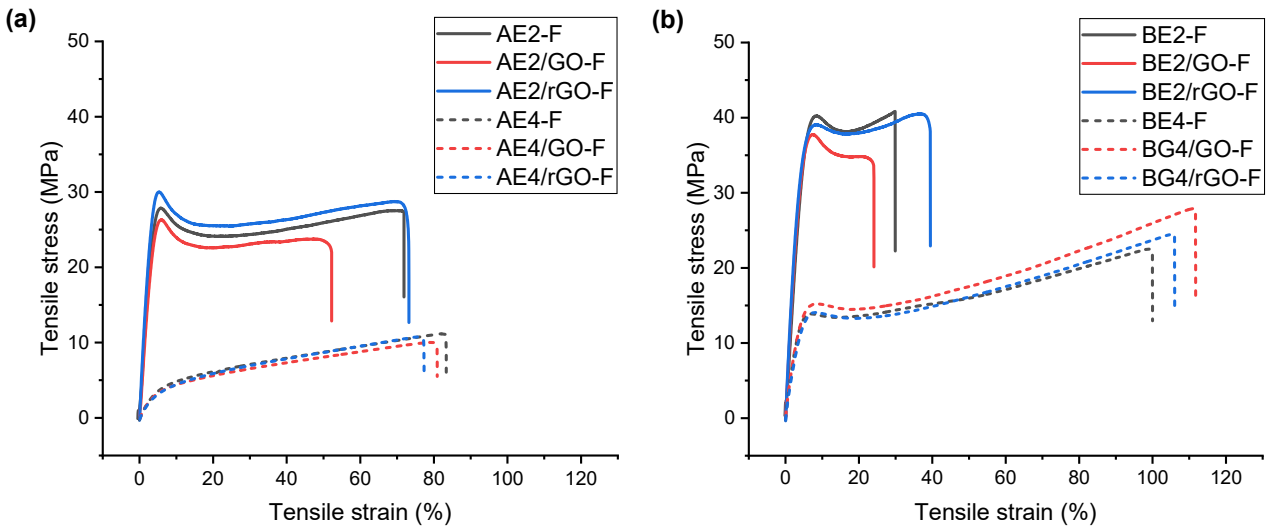

Figure S3. Representative stress–strain curves for the different biopolymer and bionanocomposite films: a) chitosan matrix; b) chitosan/CMC matrix.

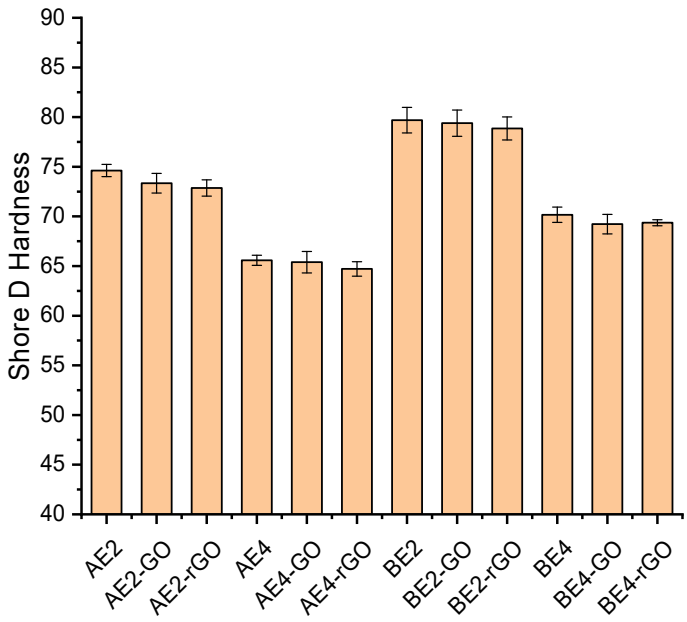

Figure S4. Shore D hardness of the different biopolymer and composite films.

3 Notes to figures

Figure S1 shows the cryo-fractured surfaces of the different biopolymer and bionanocomposite films examined by scanning electron microscopy (SEM). All the samples displayed a cohesive surface morphology, suggesting successful processing of the biopolymers.

Figure S2 (a) shows the Fourier-transform infrared (FTIR) spectrum of [C_2mim][OAc]. The bands at 536 cm^{-1}, 633 cm^{-1}, 1381 cm^{-1}, and 1580 cm^{-1} can be ascribed to the different vibration modes of the carboxylate (COO^-) on the acetate and that at 1179 cm^{-1} is attributed to the bending vibration of the carbon atoms and N─C═N on the imidazolium ring.[1]

Figure S3 shows that the stress–strain profiles of the biopolymer matrices were strongly affected by [C_2mim][OAc] content. Excess (40 wt%) IL made the A-samples behave more like elastomeric materials whereas the other samples still behaved like hard and tough plastics.

Figure S4 shows the Shore D hardness for the different samples, which generally match the trends observed for E and σ_t. The Shore D hardness is mainly influenced by the IL content while the effect of GO/rGO was negligible. The B-samples with 20 wt% [C_2mim][OAc] had the highest Shore D hardness. It appears that PEC between the two biopolymers resulted in higher hardness.

References

1. Marekha, B. A.; Bria, M.; Moreau, M.; De Waele, I.; Miannay, F.-A.; Smortsova, Y.; Takamuku, T.; Kalugin, O. N.; Kiselev, M.; Idrissi, A., Intermolecular interactions in mixtures of 1-n-butyl-3-methylimidazolium acetate and water: Insights from IR, Raman, NMR spectroscopy and quantum chemistry calculations. *J. Mol. Liq.* **2015,** *210*, 227-237.