

Supplementary Material

Impact of Polyimide Semi-Interpenetrating Polymer Networks on the Physicochemical Properties of Vulcanized Acrylonitrile–Butadiene Rubber

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Flow time for DMF: 7.27 ± 0.06

Flow time for diluted PAA solution (0.05 wt%): 8.13 ± 0.06

$\eta_{\text{relative}} = 8.13/7.27 = 1.118$

$\eta_{\text{specific}} = 1.118 - 1 = 0.118$

$\eta_{\text{reduced}} = 0.118/[0.05] = 2.36 \text{ dL/g}$

As an approximation, the reduced viscosity (η_{reduced}) was used as the reduced viscosity ($\eta_{\text{intrinsic}}$) as the PAA concentration (0.05 wt%) was close to near zero, where intrinsic viscosity is defined.

Given the Mark-Hounwink equation: $[\eta] = KM^\alpha$, where Mv = viscosity-average molecular weight, $K = 1.85 \times 10^{-4} \text{ dL/g}$, and $\alpha = 0.8$ (these two parameters are adopted from a standard aromatic PAA system derived from pyromellitic dianhydride and 4,4'-oxydianiline).

$[2.36 \text{ dL/g}] = (1.85 \times 10^{-4} \text{ dL/g}) M^{\alpha} \rightarrow Mv \approx 136,000 \text{ g/mol}$

Figure S1. A photo of the capillary Ostwald viscometer setup and calculation of the viscosity-average molecular weight (Mv) of the synthesized polyamic acid (PAA) using the Mark–Houwink relationship.

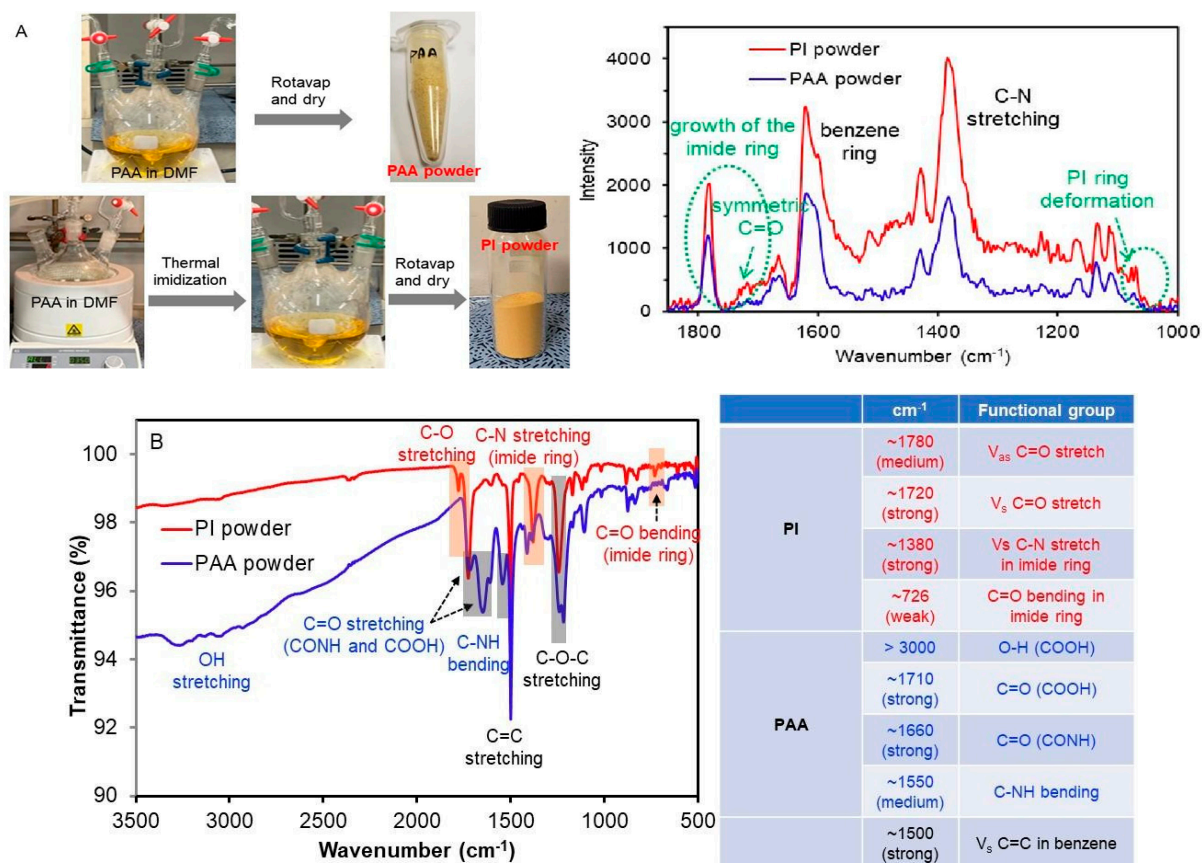


Figure S2. Digital photos presenting PAA and PI powder preparation in the absence of NBR along with corresponding Raman (A) and FT-IR (B) spectroscopy (note: The small-scale imidization reaction without a reflux condenser often resulted in significant solvent loss and premature solidification of the reaction mixture).

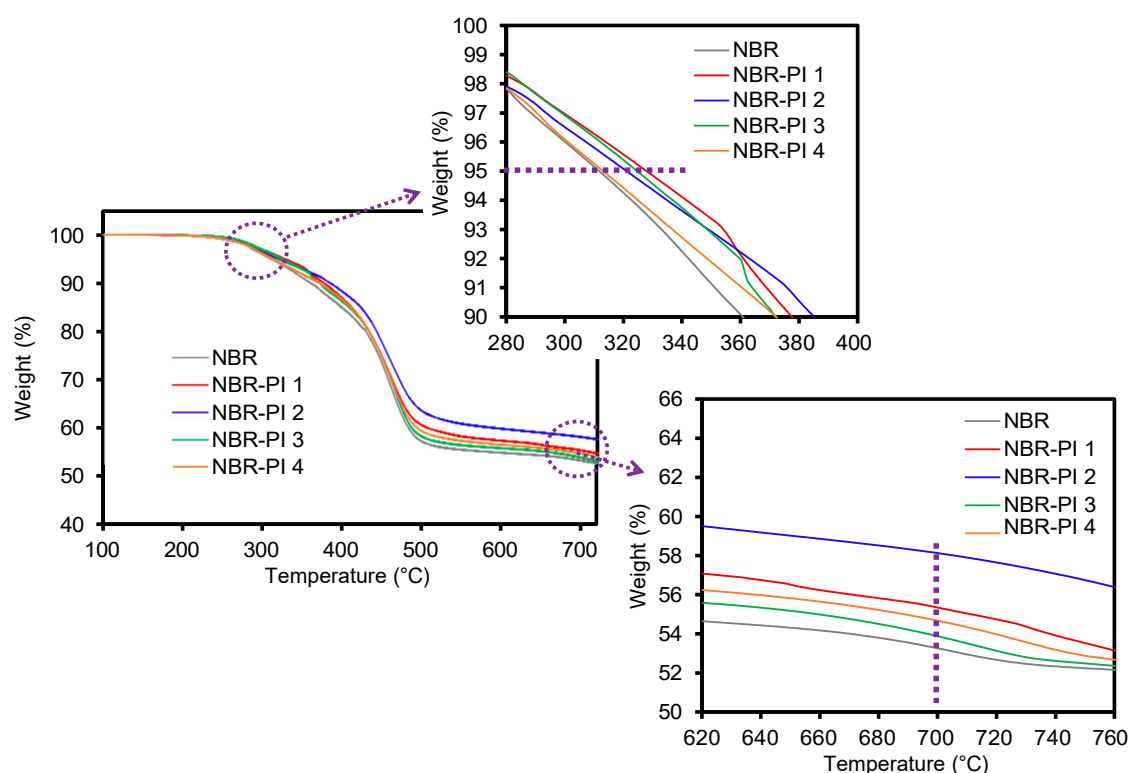


Figure S3. TGA thermograms of NBR and NBR-PI semi-IPNs after DMF solvent removal by heating at 100 °C for at least 30 min.

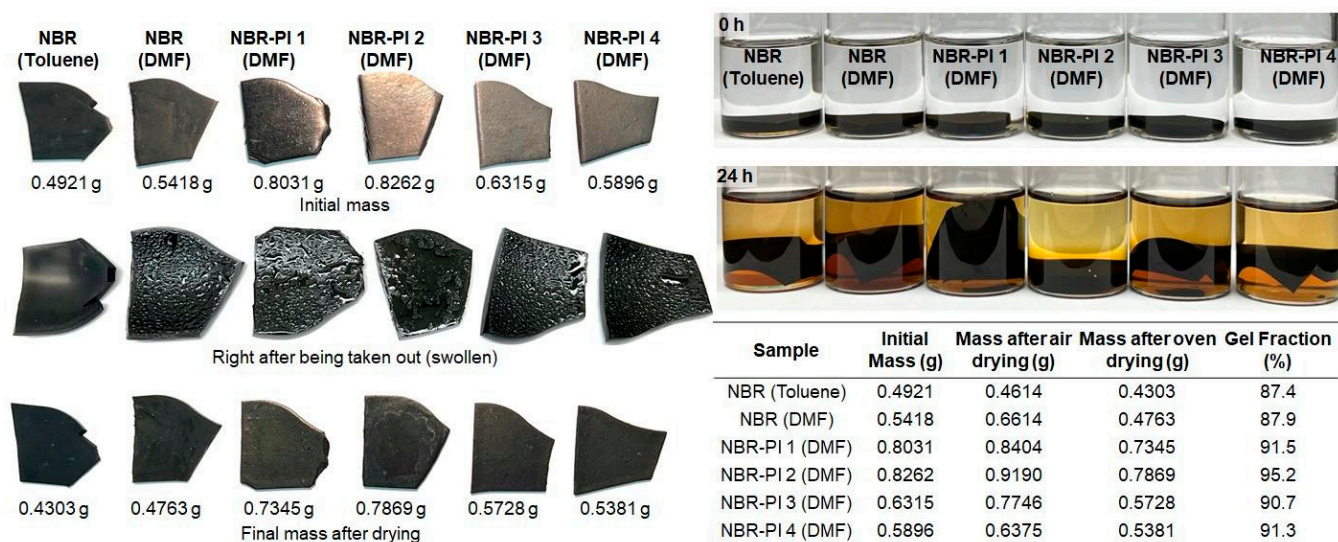


Figure S4. Digital photographs of the rubber samples before and after gel fraction measurements, along with the corresponding gel fractions (%).

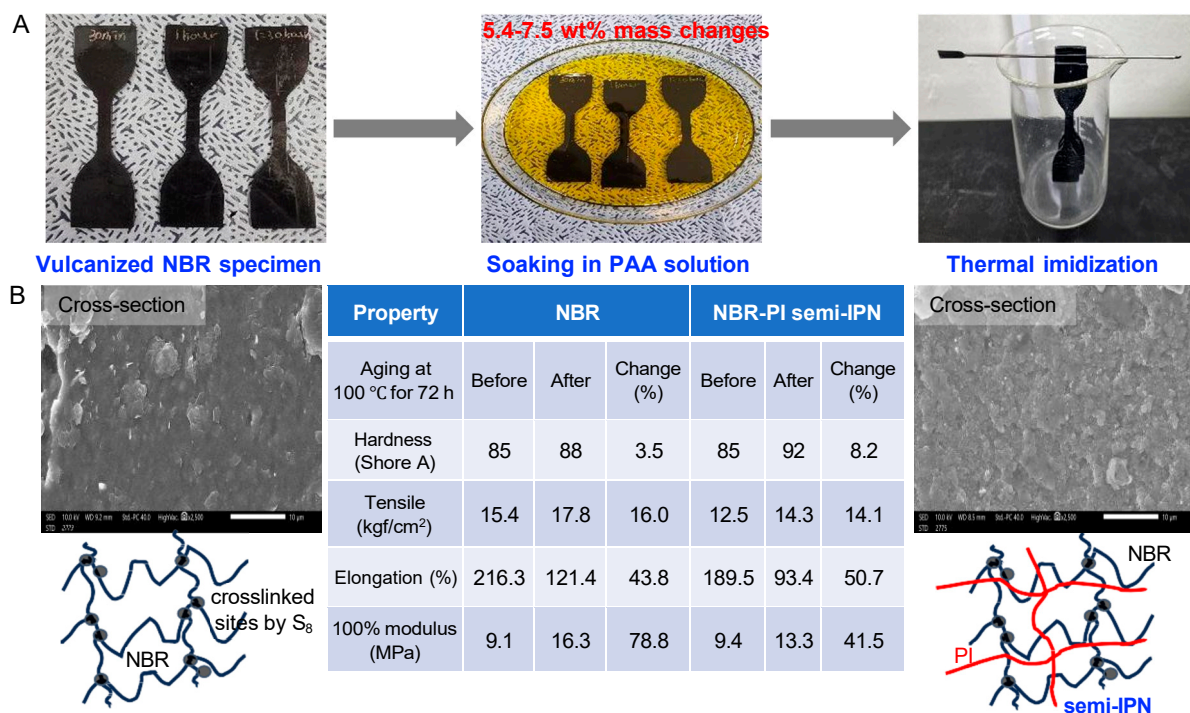


Figure S5. Conventional preparation of NBR-PI semi-IPNs via a modified soaking method (A), along with cross-sectional images and mechanical properties of vulcanized NBR and NBR-PI semi-IPNs (B).