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Supporting Information

Design of Softened Polystyrene for Crack- and Contamination-Free Large-Area Graphene Transfer

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Table S1. FTIR peak positions corresponding to polystyrene and DIPB

Wavenumber (cm^{-1})	Assignment
3085, 3020	C-H (sp^2, aromatic)
2924, 2840	C-H (sp^3, stretch)
1642, 1479	C=C (stretch)
1467, 1378	CH_2, CH_3 (sp^3, bend)
1030	=C-H (bending in ring plane)
750, 670	=C-H (oop bending)
820	Para-disub benzene

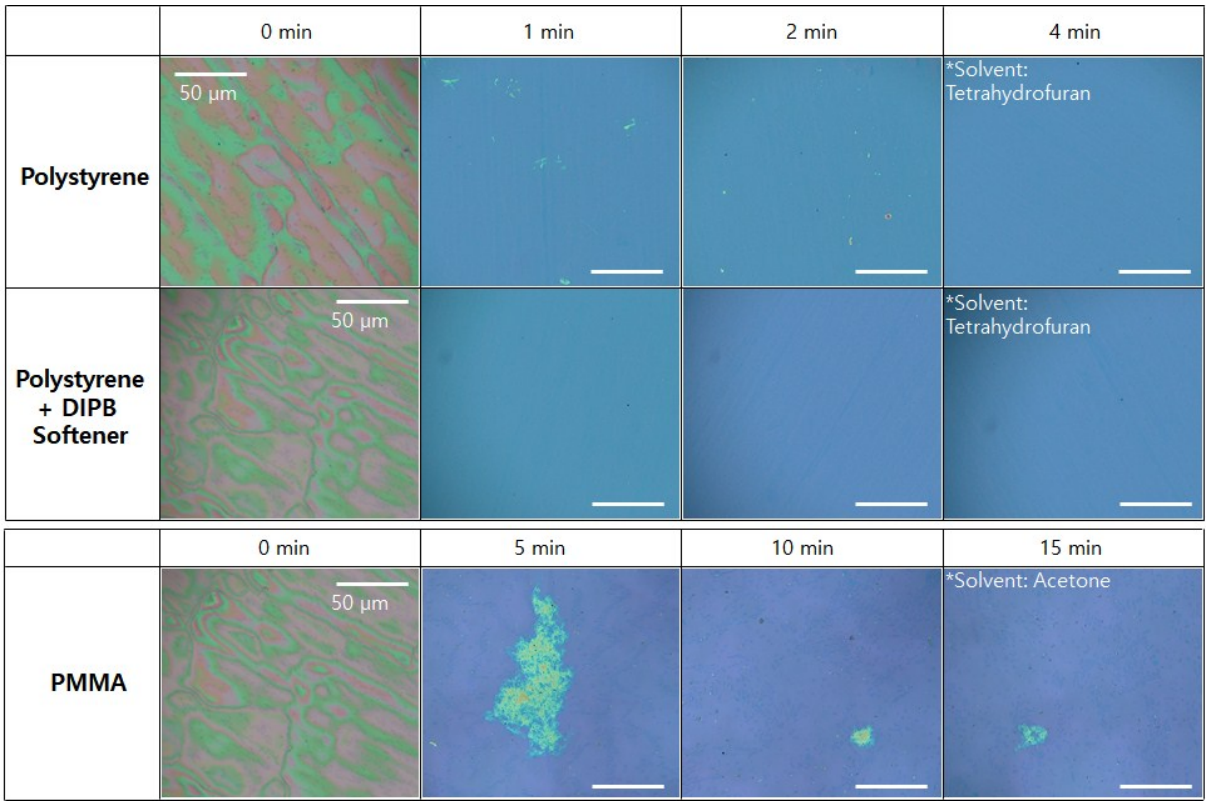

Figure S1. Comparison of solubility rate in organic solvents by optical microscopy (PS and PS with DIPB in THF solvent, PMMA in acetone solvent).

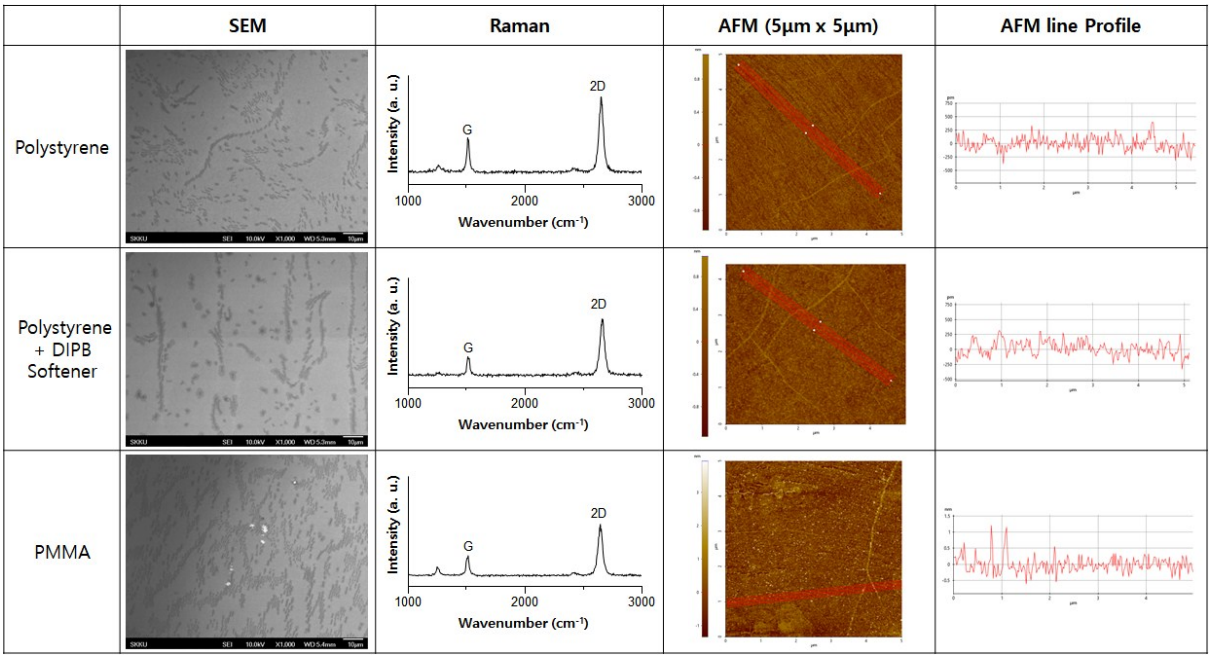

Figure S2. SEM images, Raman spectra, and AFM images (graphene on SiO_2/Si substrate, after removing polymer carrier films (PS, PS with DIPB, and PMMA).

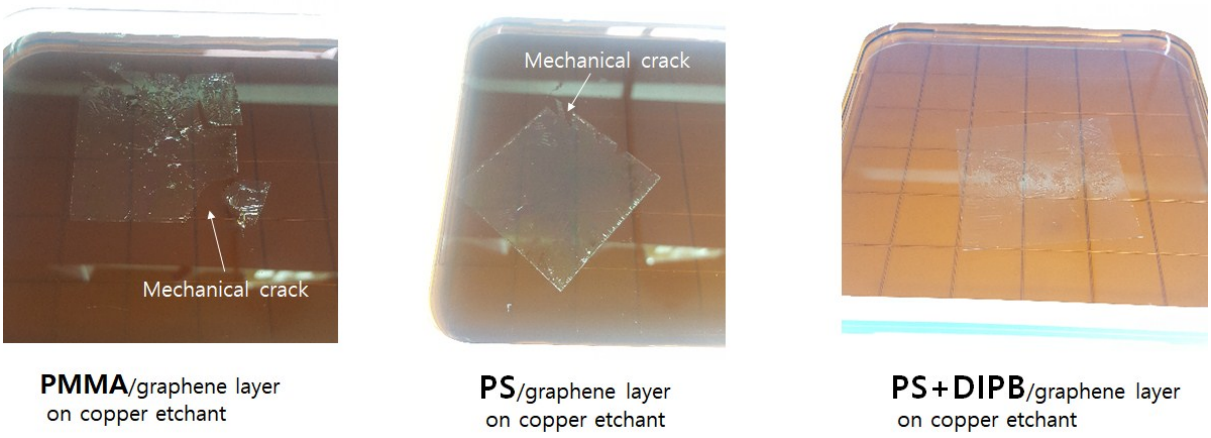

Figure S3. Mechanical cracks on carrier film during Cu-etching over large area (5 cm × 5 cm)

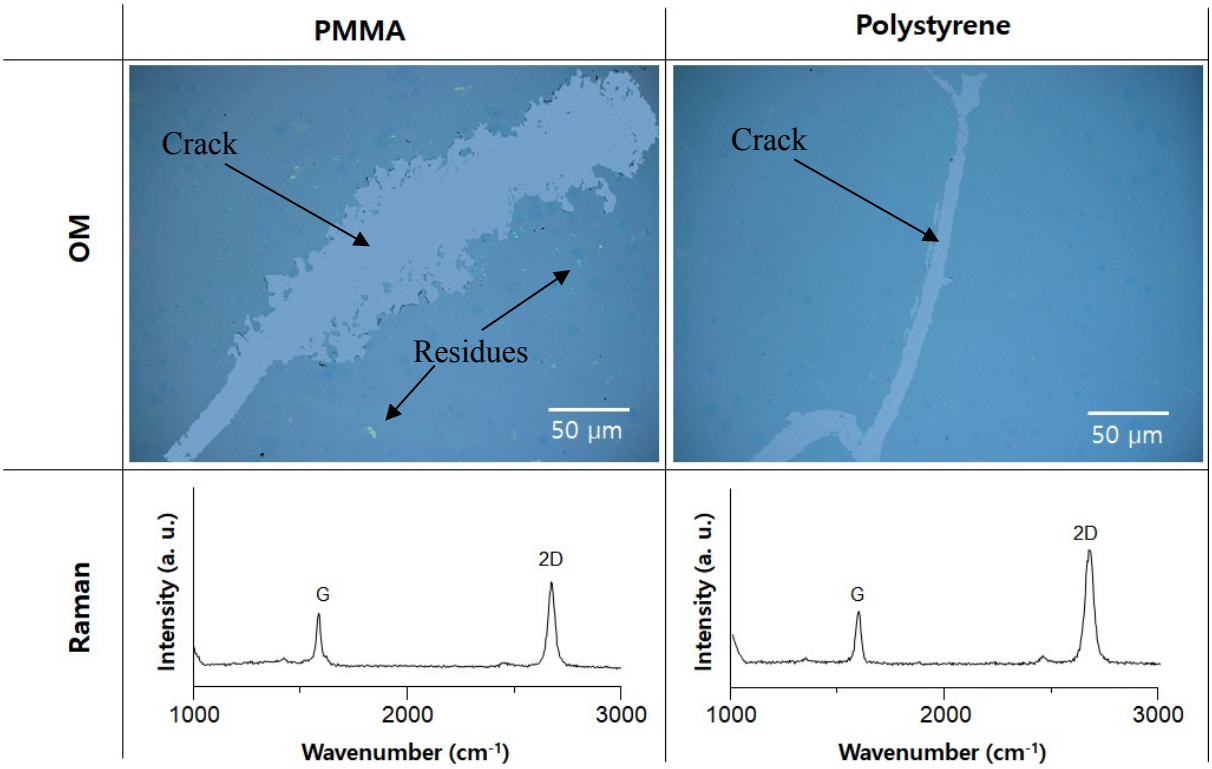

Figure S4. Test for feasibility of large-scale roll-to-roll transfer (10 cm × 10 cm size) using PMMA and pure PS carrier films. Graphene transferred by PMMA has large mechanical crack and a number of residues. Graphene transferred by pure PS without softener does have mechanical crack without any residues.

Table S2. Sheet resistance measurement of graphene transferred by PMMA, polystyrene and polystyrene + DIPB

Sheet resistance measurement with no bending stress applied										
Support Polymer	Sheet Resistance Ω/sq.									
	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7	Point 8	Point 9	Average R_s Ω/sq.
PMMA	553	727	678	806	950	524	340	552	430	617.8
PS	371	481	526	481	419	296	326	271	315	387.3
PS + DIPB Softener	444	405	456	225	540	424	351	203	331	375.4
Sheet resistance measurement after roll to roll transfer (Bending stress applied)										
Support Polymer	Sheet Resistance Ω/sq.									
	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7	Point 8	Point 9	Average R_s Ω/sq.
PMMA	649	X	781	X	594	X	961	642	X	725.4
PS	339	368	X	350	360	X	564	X	564	424.2
PS + DIPB Softener	305	450	392	362	216	512	261	360	412	363.3

Measurement Points for Sheet Resistance measurement