

Supporting Information

Introduction of reversible urethane bond based on vanillyl alcohol for efficient self-healing of polyurethane

Dae-Woo Lee †, Han-Na Kim †, and Dai-Soo Lee *

Division of Semiconductor and Chemical Engineering, Chonbuk National University, Baekjedaero 567, Jeonju 54896, Republic of Korea; dwlee2310@hanmail.net (D.W.L.); hnk07@hanmail.net (H.N.K.)

† Contributed equally to this work

* Correspondence: daisoolee@jbnu.ac.kr; Tel.: +82-63-270-2310

Table S1. Thermal properties of synthesized PUs.

Sample code	Temperature (°C)			
	5% T _d * ¹	10% T _d * ¹	T _{gs} * ²	T _{flow} * ²
Control PU	311	331	-29	148
VA10	303	317	-31	133
VA20	301	316	-25	129
VA30	300	315	-17	129
VA40	298	315	-9	125
VA40-5	297	313	-14	131
VA40-10	295	313	-20	127

*¹ T_d was measured by TGA

*² T_{gs} and T_{flow} were measured by DMA

Table S2. Relaxation time and activation energy of synthesized PUs.

Sample code	Relaxation time (s)					Activation energy (kJ/mol)
	120 °C	130 °C	140 °C	145 °C	150 °C	
Control PU	-	-	539	241	98	247.6
VA10	-	220	71	-	33	134.6
VA20	-	315	102	-	38	149.9
VA30	-	380	120	-	45	151.2
VA40	-	614	162	-	55	171.1
VA40-5	408	147	65	-	-	124
VA40-10	294	114	59	-	-	108.5

Table S3. Tensile strength and healing efficiency of synthesized PUs at 140 °C for 30 min.

Sample code	Tensile strength (MPa)		Healing efficiency (%)
	Before healing	After healing	
Control PU	25.5	17.7	69.3
VA10	29.5	17.8	60.5
VA20	32.8	16.6	50.7
VA30	35.7	15.3	42.9
VA40	37.2	12.1	32.4
VA40-5	18.4	16.3	88.4
VA40-10	14.9	14.4	96.5

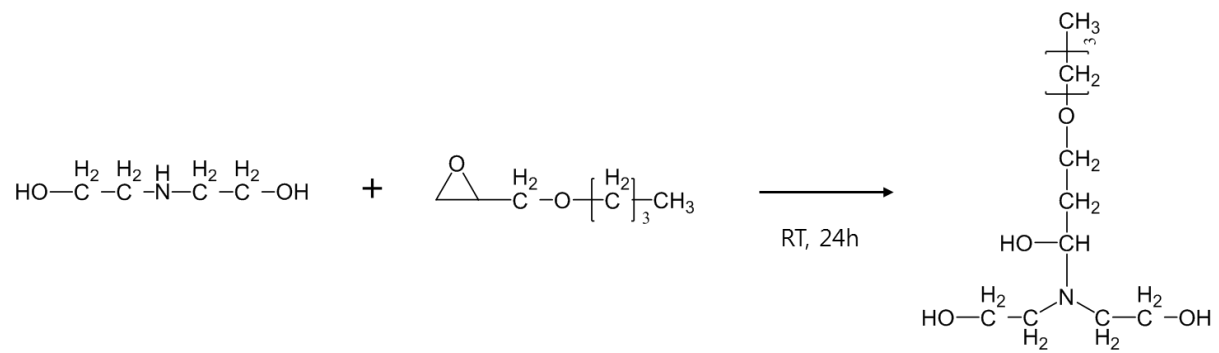


Figure S1. Synthesis of m-CE.

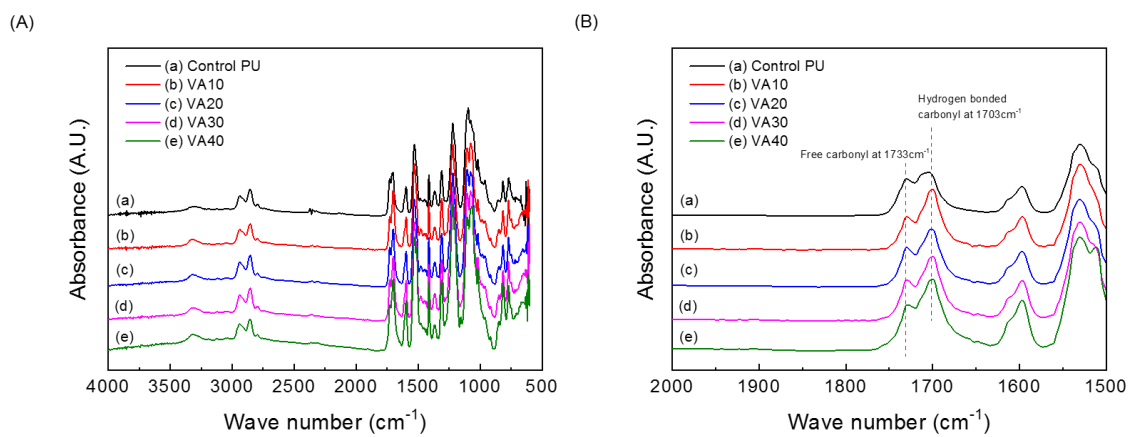


Figure S2. FT-IR spectra of VA-based PUs.

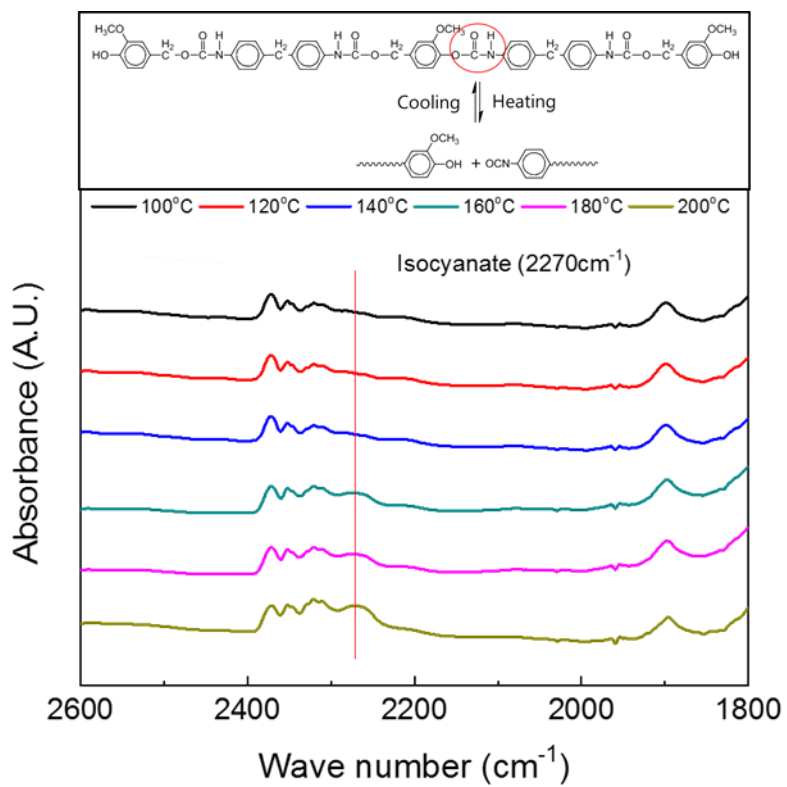


Figure S3. FT-IR spectra of model structure for reversible urethane bond at elevated temperature.

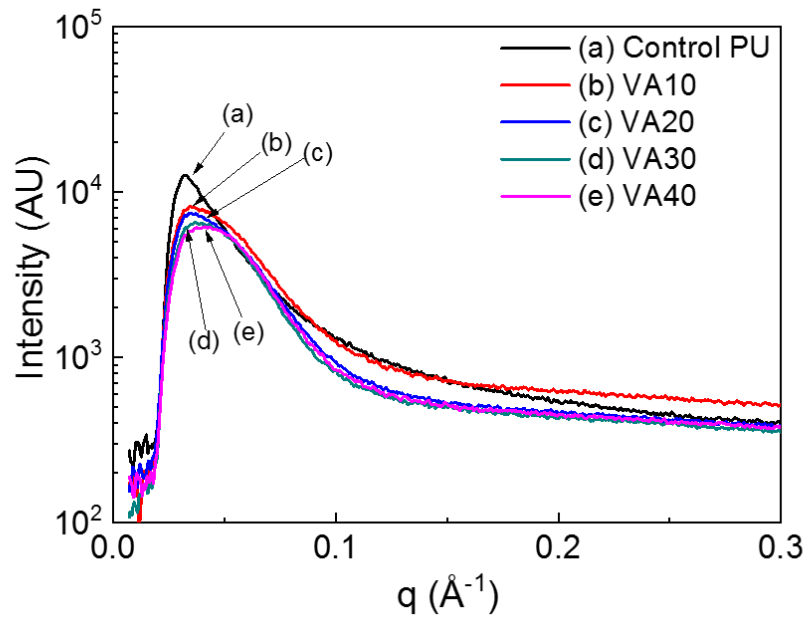


Figure S4. SAXS profile of VA-based PUs.

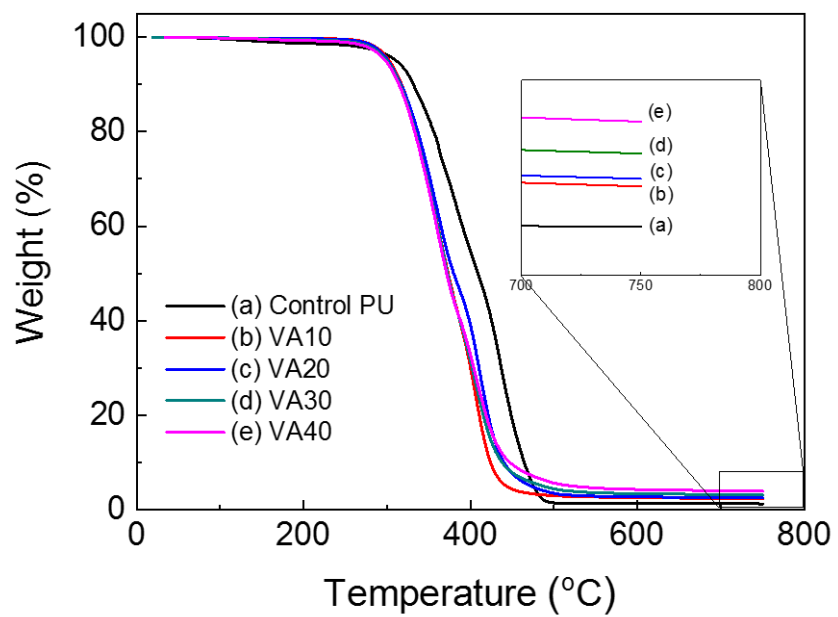
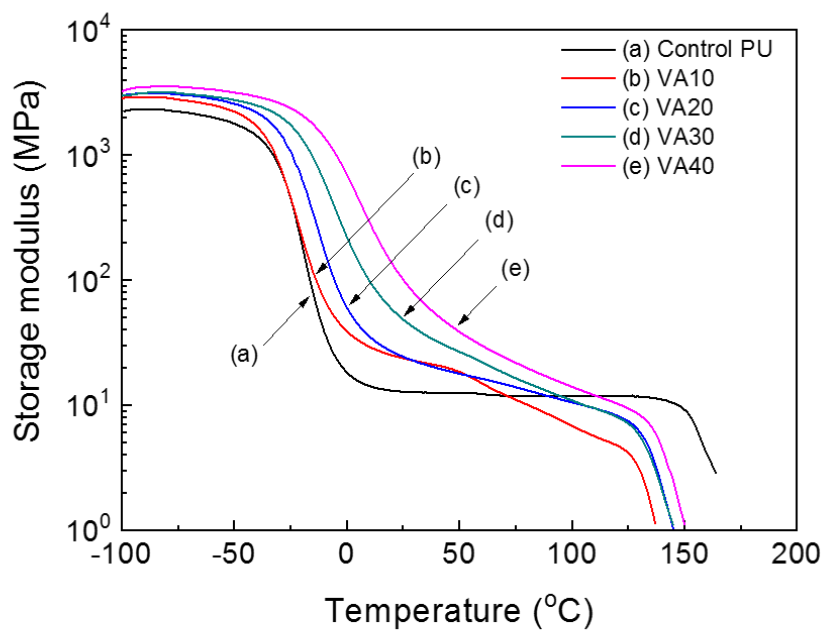


Figure S5. TGA thermograms of VA-based PUs.

(A)



(B)

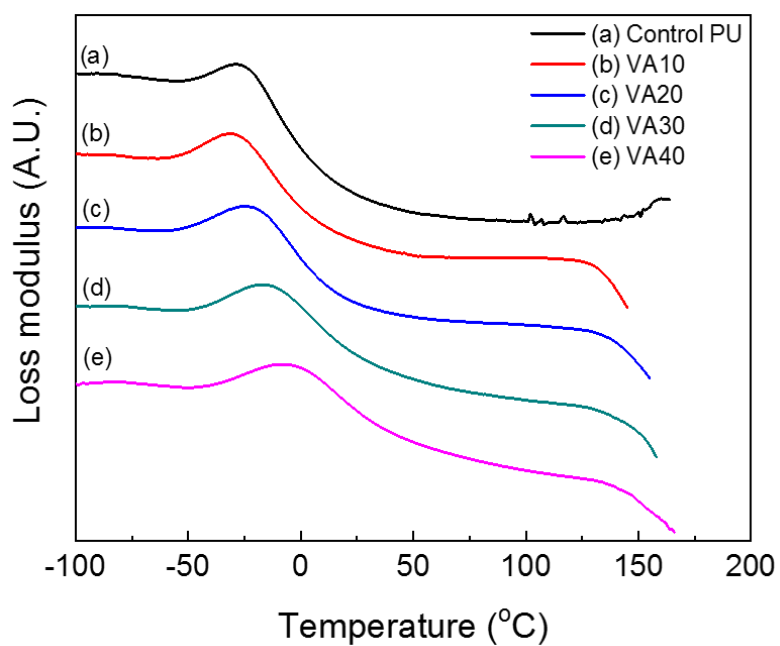


Figure S6. DMA thermograms of VA-based PUs.

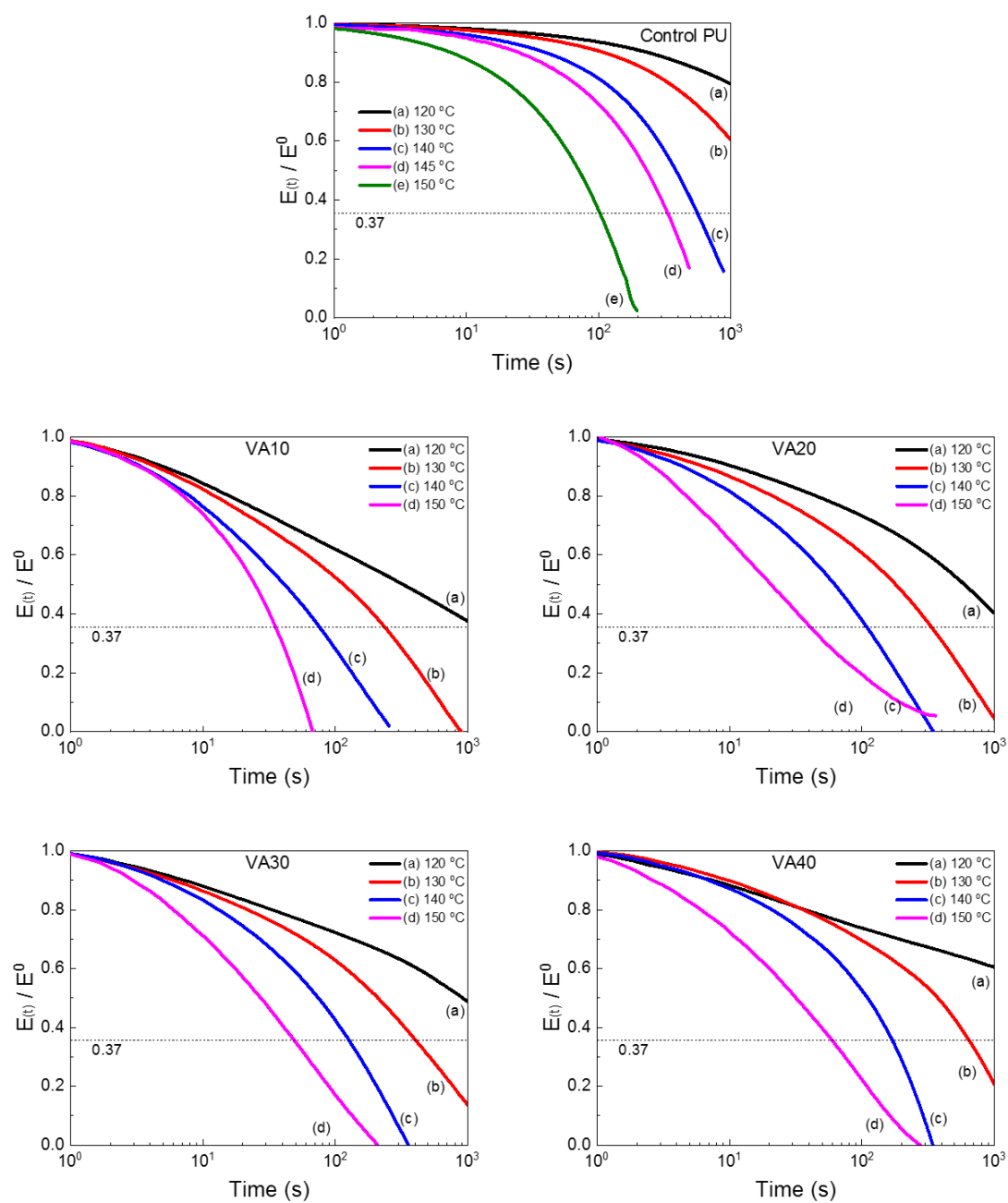


Figure S7. Stress-relaxation curves of the VA-based PUs at various temperatures.

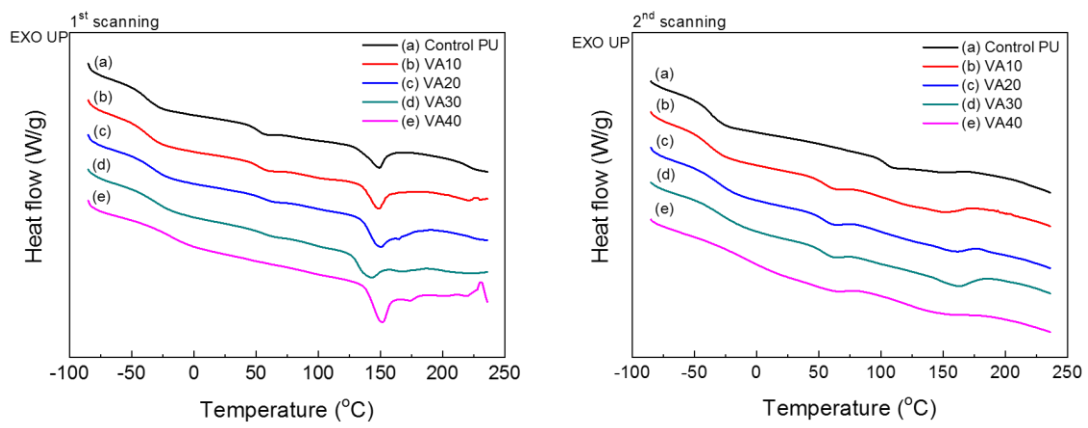


Figure S8. DSC thermograms of VA-based PUs.

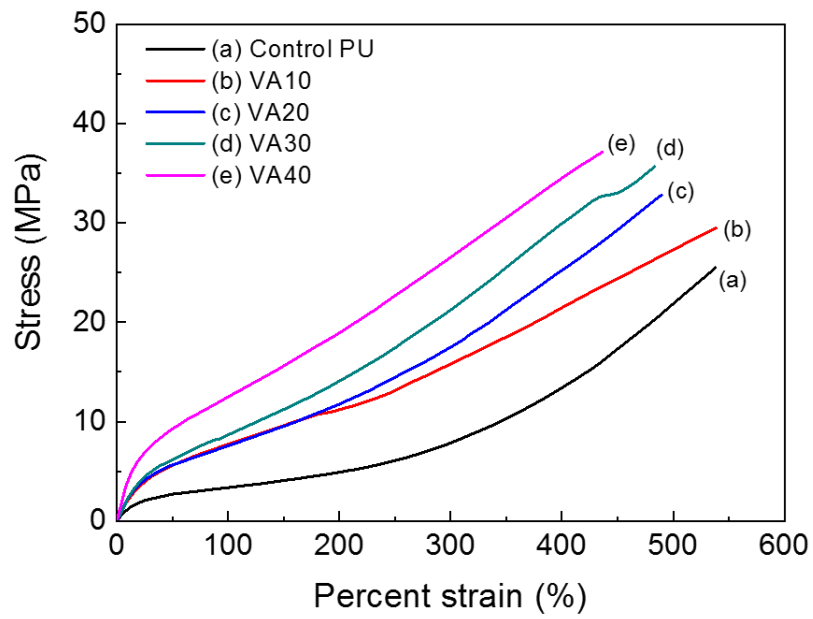


Figure S9. Stress-strain curves of VA-based PUs.

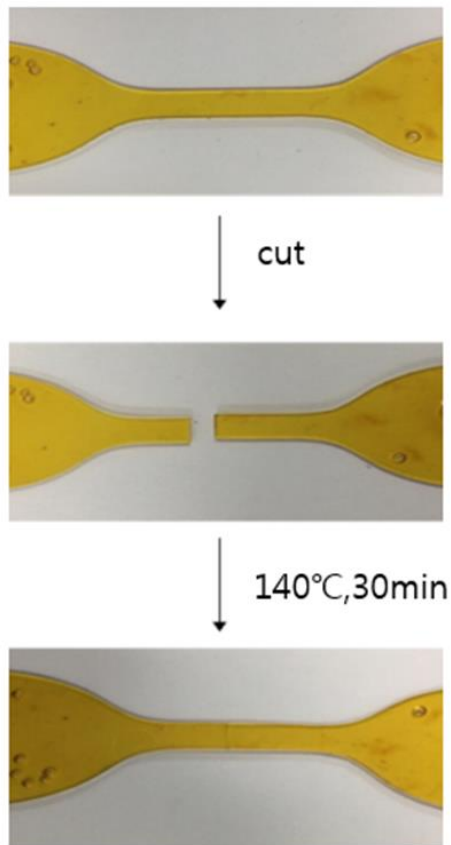


Figure S10. Images of self-healing test specimens for VA40-10.

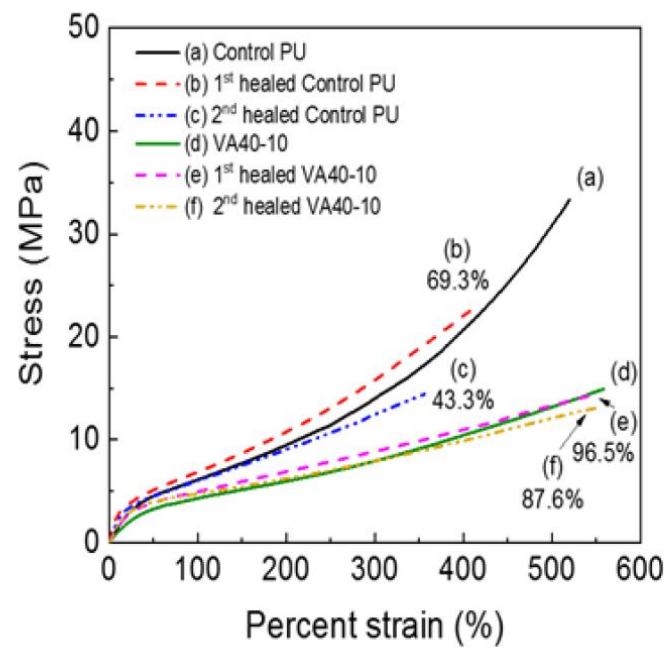


Figure S11. Tensile properties of PUs after repeated healing at 140 °C.

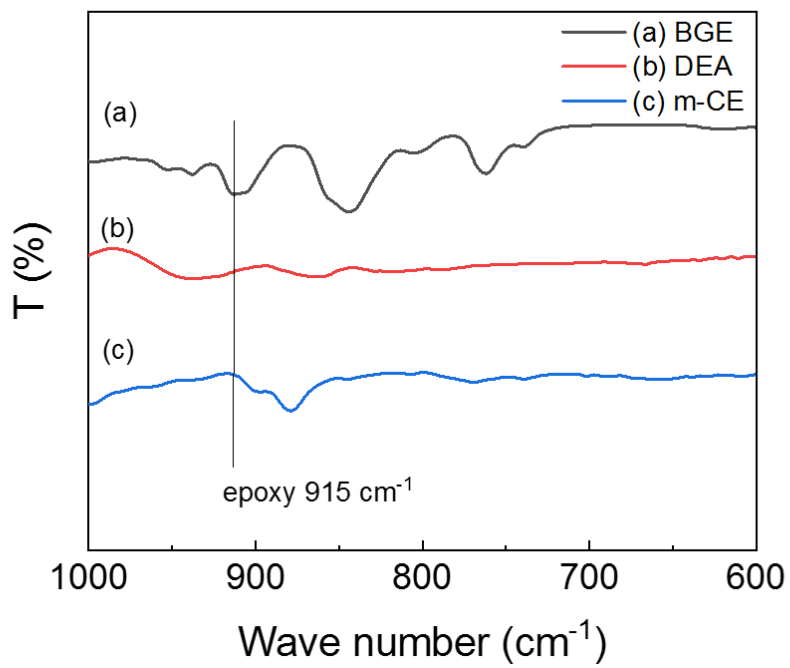


Figure S12. FT-IR spectra of DEA, BGE and m-CE.

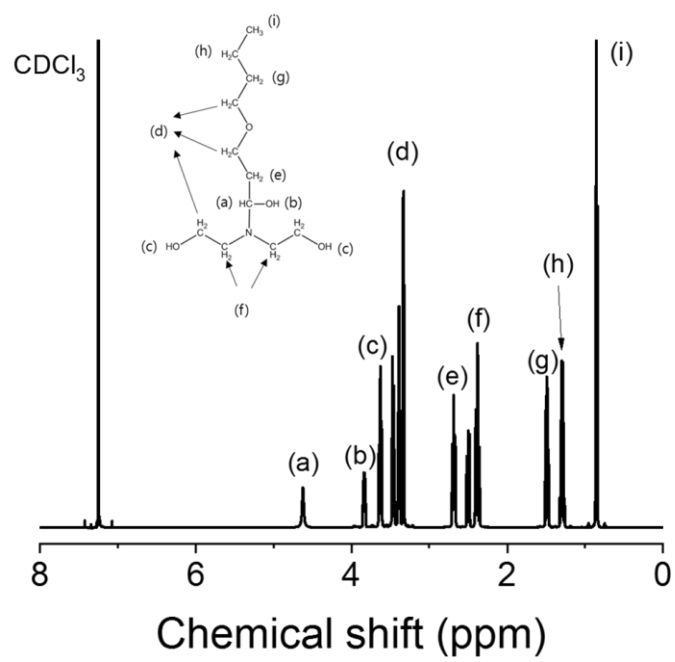


Figure S13. NMR spectrum of m-CE.