SUPPORTING INFORMATION

Polyurethane by Ionic Liquid Crosslink; A New Class of Super Shape-Memory Like Polymer

Prasanta Kumar Behera, Prantik Mondal, Nikhil K. Singha*

Rubber Technology Centre, Indian Institute of Technology, Kharagpur 721302, India

*Corresponding Author E-mail: nks@rtc.iitkgp.ernet.in
Tel.: +91 3222 283178, Fax: +91 3222 255303.

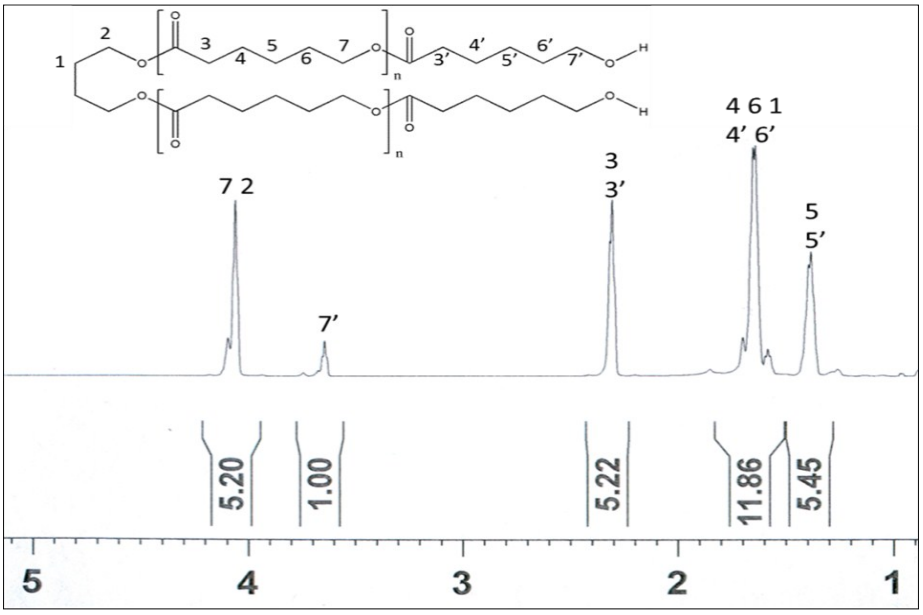


Fig S1: ^{1}H NMR spectrum of PCL-diol.

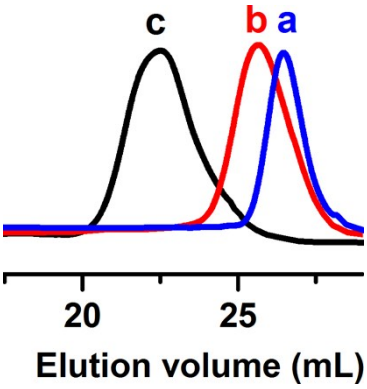


Fig S2: GPC traces of (a) PCL-diol (M_n = 1360, Đ = 1.17) (b) Isocyanate terminated prepolymer (M_n = 2150, Đ = 1.39), and (c) PU-BDO (M_n = 29847, Đ = 1.72)

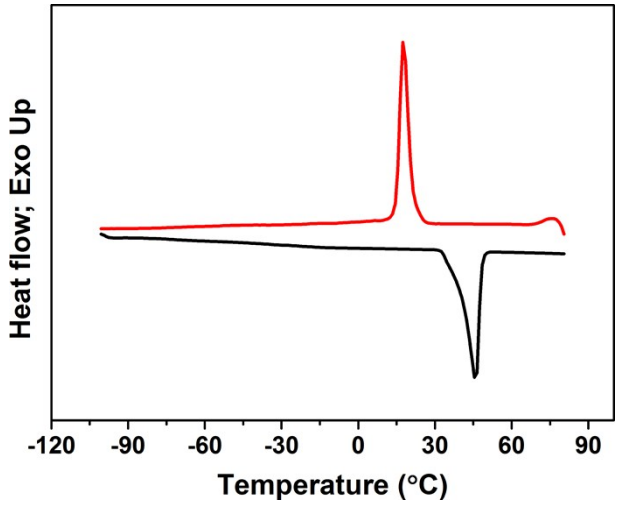
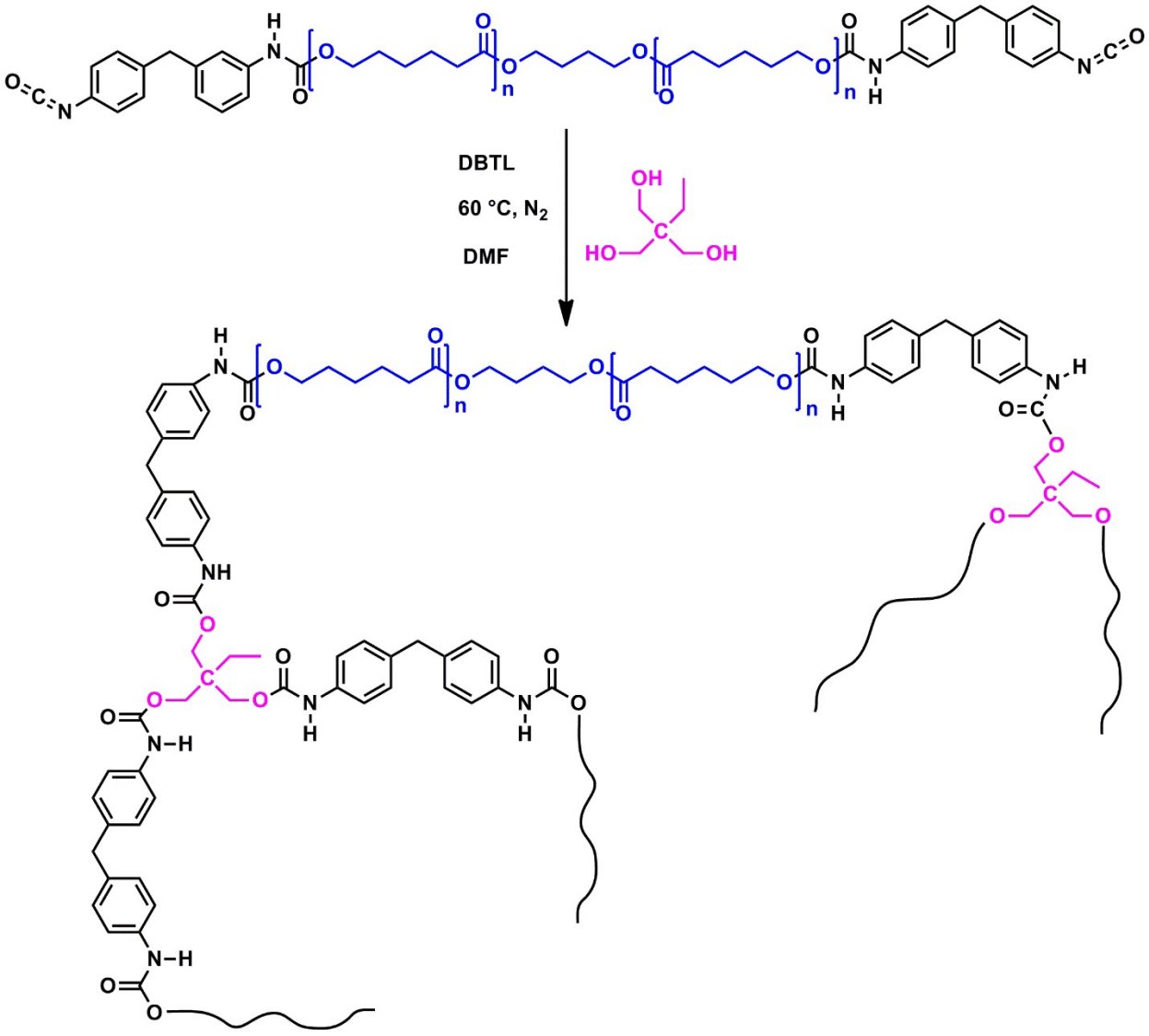
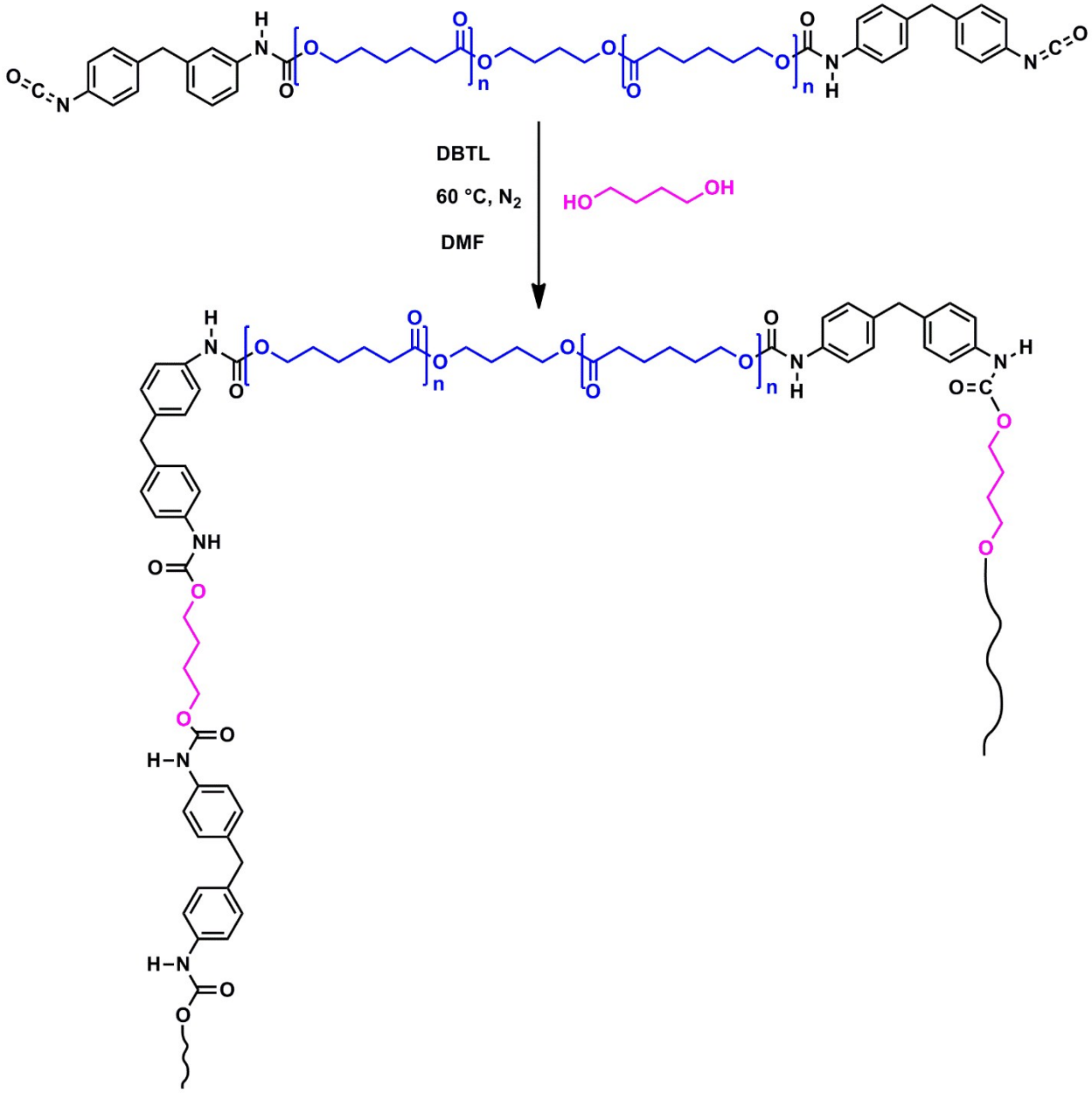


Fig S3: DSC thermograms of PCL-diol. obtained at heating and cooling rate of 10 °C/min.



Scheme S1: Synthesis of non-ionic cross-linked polyurethane (PU-TMP).



Scheme S2: Synthesis of linear polyurethane (PU-BDO).

Table S1: Crosslink density of PU-IL and PU-TMP.

Sample	V_e (cm^3)	V_r	$C_d \times 10^4$ (mol/cm^3)
PU-IL	0.4172	0.2765	2.43
PU-TMP	0.3982	0.2792	2.51

*(V_e = equilibrium volume of swollen sample, V_r = volume fraction of the crosslinked polymer in the swollen sample and C_d = rosslink density).

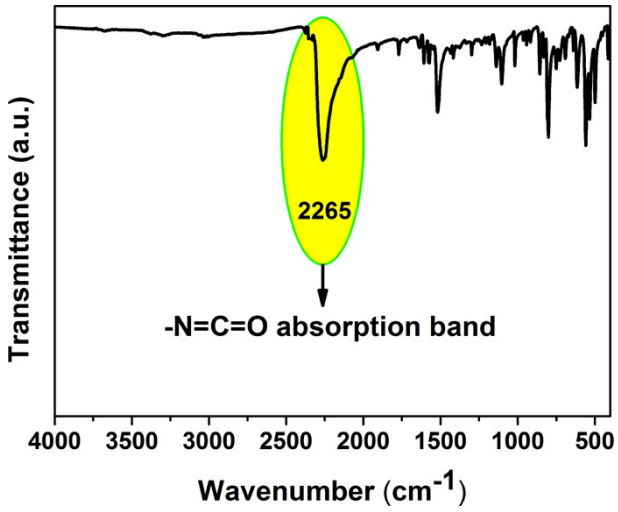


Fig S4: FTIR spectrum of MDI.

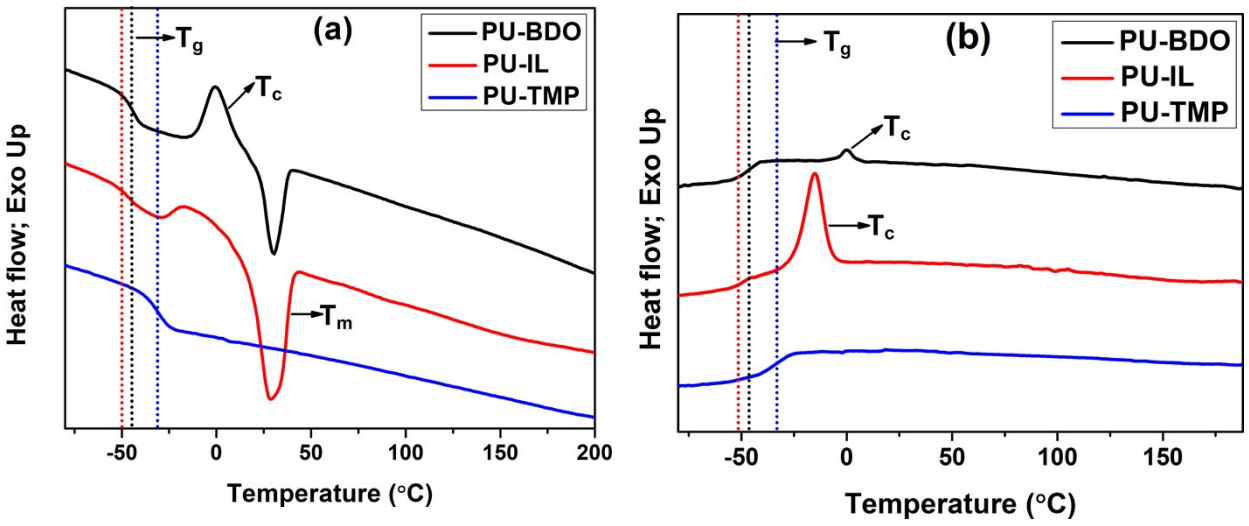


Fig S5: DSC heating (a) and cooling (b) thermograms of PU-BDO, PU-IL, and PU-TMP in the temperature range -80 °C to 200 °C (heating and cooling rate = 10 °C/min).

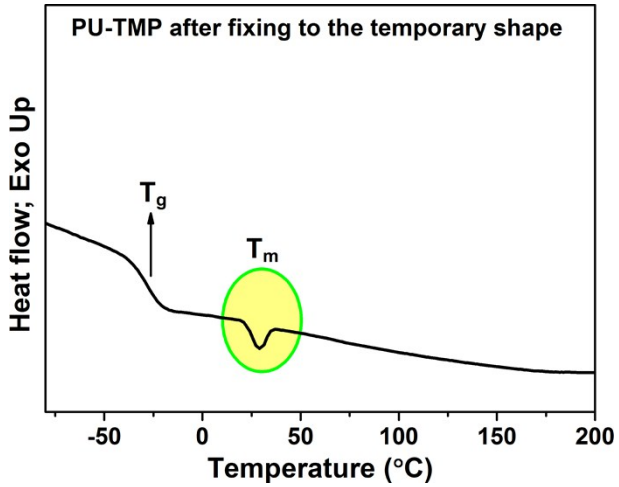


Fig S6: DSC heating thermogram of PU-TMP after fixing to temporary shape (T_g = -29 °C, T_m = 28.8 °C, $\Delta H_m{}^a$ = 2.1 J/g, $\Delta H_m{}^b$ = 3.08 J/g and X_c = 2.3%).

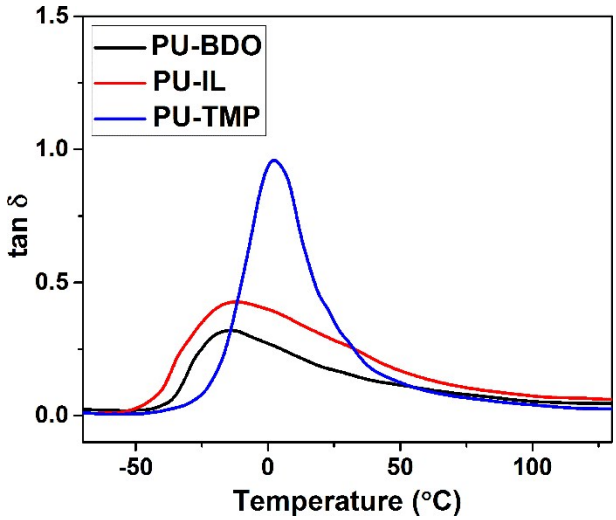


Fig S7: Plots of tan δ vs. temperature for PU-BDO, PU-IL, and PU-TMP (heating rate 10 K/min).

The stress-strain plot (Figure S7) for all SMPUs was obtained by stretching the samples to 100% elongation at two different temperature (20 °C and 50 °C), and the respective modulus values were reported in Table S2. The trend in the tensile modulus (modulus at 100% elongation) of PU-BDO, PU-TMP, and PU-IL is completely different at 20 °C and 50 °C. At 20 °C the modulus of PU-BDO > PU-IL > PU-TMP, whereas at 50 °C modulus of PU-TMP > BDO > PU-IL. Thus the trend in modulus obtained from DMA analysis is in complete agreement with the tensile analysis.

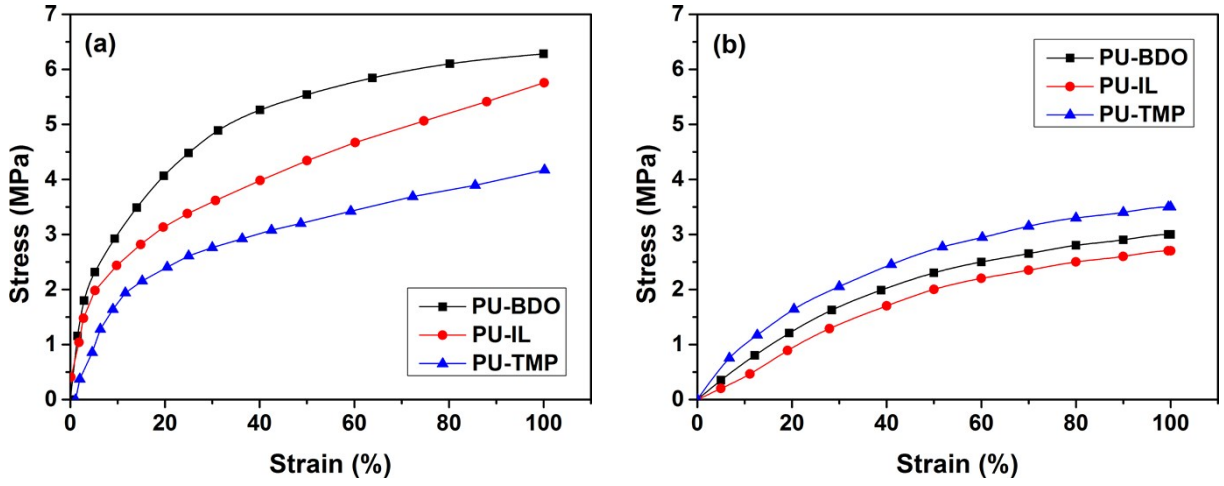


Fig S8: Typical stress-strain plots of the PU BDO, PU-IL, and PU-TMP at (a) 20 °C and (b) 50 °C.

Table S2: Tensile modulus of PU-BDO, PU-IL and PU-TMP at room temperature and at 50 °C.

Sample	Modulus at 100% strain (MPa) at room temp.	Modulus at 100% strain (MPa) at 50 °C	Reduction in modulus (%)
PU-BDO	6.26	2.99	52.23
PU-IL	5.80	2.60	55.17
PU-TMP	4.15	3.50	15.66

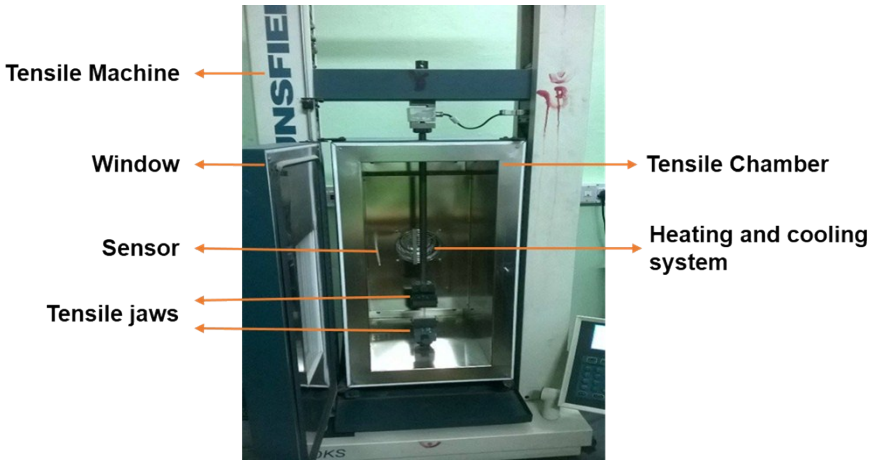


Fig S9: Cyclic tensile testing machine attached with thermal chamber.

Table S3: Water absorption by PU-BDO, PU-IL and PU-TMP at 50 °C.

Sample	Water absorption (%)	
	Normal water	Salt water
PU-BDO	1.2±0.06	1.0±0.03
PU-IL	2.0±0.09	2.8±0.08
PU-TMP	0.9±0.04	0.7±0.02