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## **Supporting Information to**

Unusual Thermal Phase Transition Behavior of the Ionic Liquid and Poly Ionic Liquid in Water with Significantly Different LCST and Dynamic Mechanism

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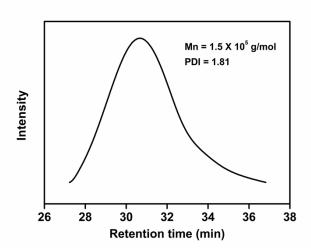
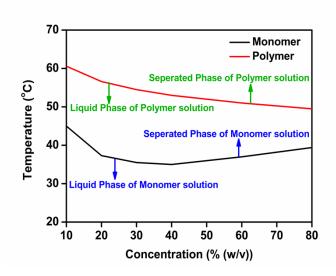


Fig. S1 The number-average molecular weight  $(M_n)$  and polydispersity index  $(PDI = M_w/M_n)$  of the synthetic  $P[P_{4,4,4,4}][SS]$ .



**Fig. S2** Phase diagram of Temperature vs. concentration for both monomer and polymer in water according to the DSC results.

**Table S1** The final results of multiplication on the signs of each cross-peak in synchronous and asynchronous spectra of  $[P_{4,4,4,4}][SS]$  solution (20 % (w/v))during heating.

1124	+	+	+	+	+	+	+	
1132	+	+	+	+	+	+		
2869	-	+	-	+	-			
2885	+	+	-	+				
2927	-	+	-					
2942	+	+						
2958	-							
2975								
	2975	2958	2942	2927	2885	2869	1132	1124

**Table S2** The final results of multiplication on the signs of each cross-peak in synchronous and asynchronous spectra of  $P[P_{4,4,4,4}][SS]$  solution (20 % (w/v))during heating.

1122	+	+	+	+	+	+	+	
1122		Т		Т	Т		Т	
1132	-	-	-	-	-	-		
2871	+	+	-	-	+			
2883	-	-	-	-				
2929	+	+	-					
2940	+	+						
2958	+							
2974								
	2974	2958	2940	2929	2883	2871	1132	1122