

Ultrathin stimuli-responsive polymer film based optical sensor for fast and visual detection of hazardous organic solvents

Zhaoyi Wang,^a Xueyao Liu,^a Yuxin Wu,^a Bingbing Liu,^b Zhanhua Wang,^c Junhu Zhang,^a Kun Liu,^a and Bai Yang^{*a}

a. State Key Laboratory of Supramolecular Structure and Materials, College of Chemistry, Jilin University, Changchun 130012, P. R. China.

b. State Key Laboratory of Superhard Materials, College of Physics, Jilin University, Changchun 130012, P. R. China.

c. State Key Lab of Polymer Materials Engineering, Polymer Research Institute, Sichuan University, Chengdu 610065, China.

*E-mail: byangchem@jlu.edu.cn; Fax: +86-431-85193423; Tel: +86-431-851684789

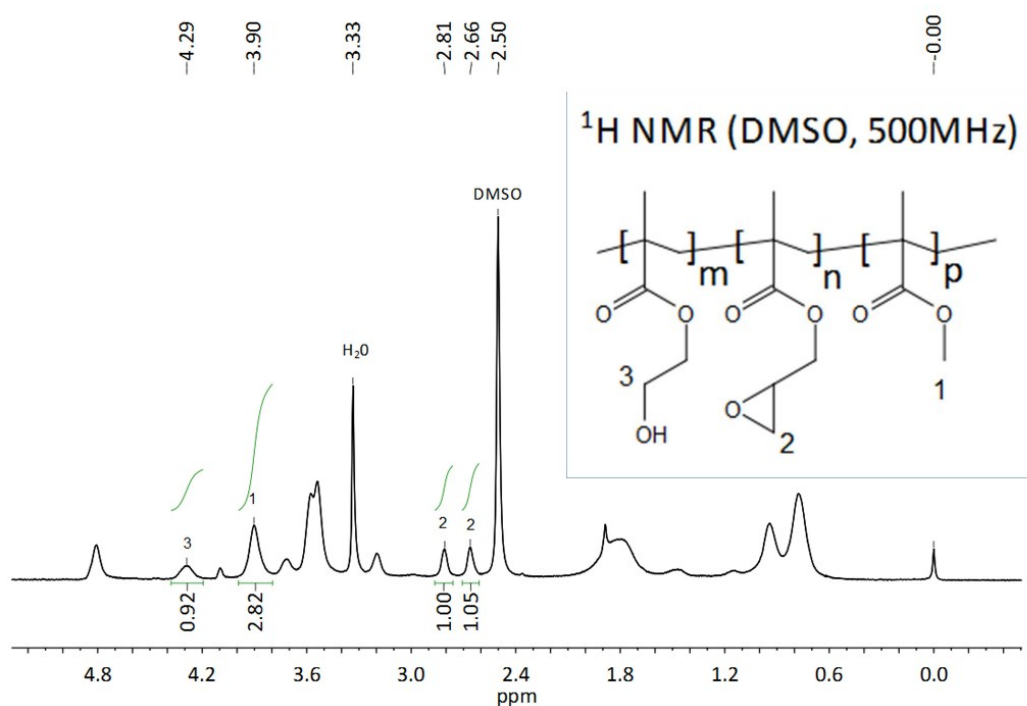


Fig. S1 ¹H NMR spectrum and structure formula (inset) of the synthetic stimuli-responsive P(MMA-co-HEMA-co-GMA).

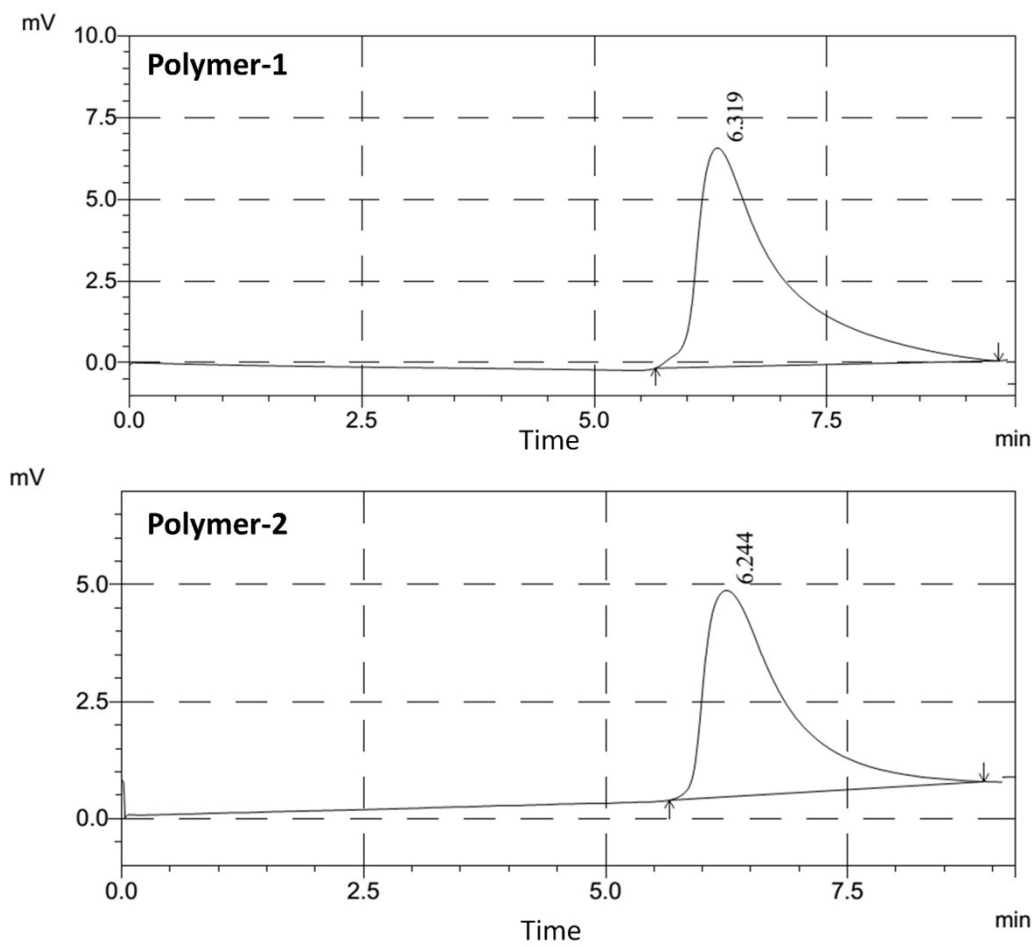


Fig. S2 GPC of the synthetic stimuli-responsive P(MMA-co-HEMA-co-GMA)-1 (Polymer-1) and P(MMA-co-HEMA-co-GMA)-2 (Polymer-2).

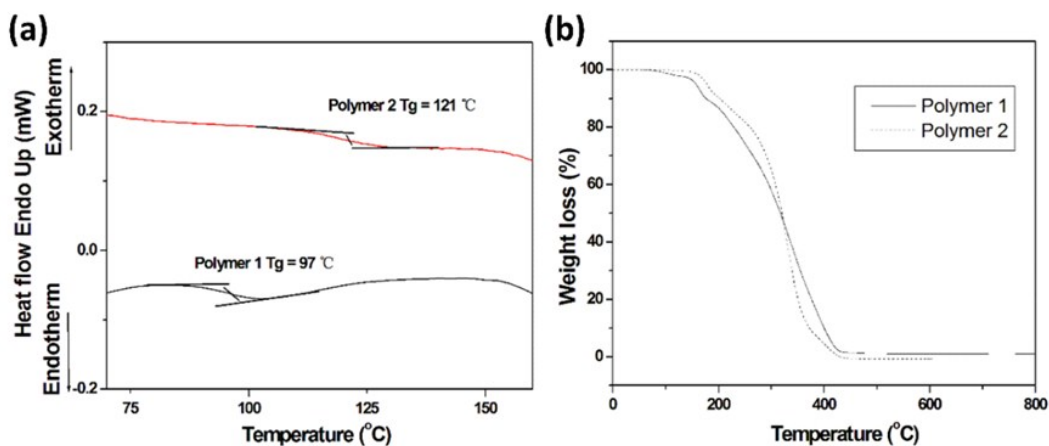


Fig. S3 (a) DSC and (b) TGA of the synthetic stimuli-responsive P(MMA-co-HEMA-co-GMA)-1 and P(MMA-co-HEMA-co-GMA)-2.

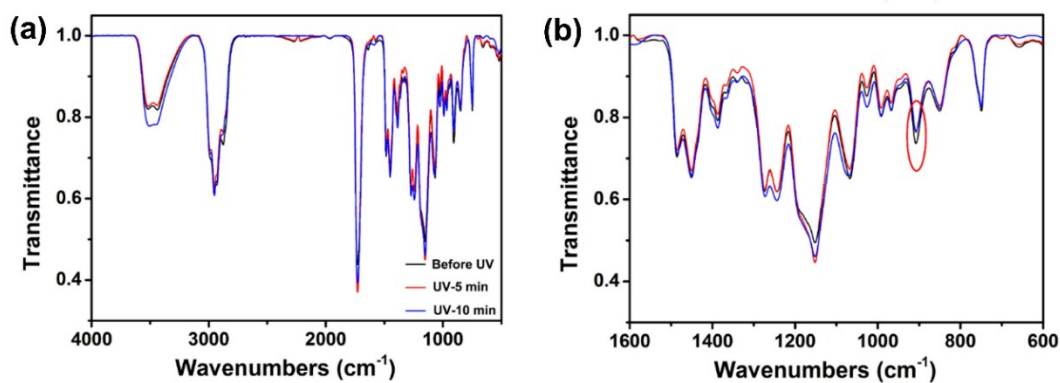


Fig. S4 (a) FTIR spectra of single polymer layer before (black), after 5 min (red) and 20 min (blue) UV-exposure in the wavenumber range between 4000 and 500 cm⁻¹ and (b) the zoom-in FTIR spectra in the range between 1600 and 600 cm⁻¹, which show the alteration of characteristic peak at 902 cm⁻¹ of epoxy group due to the UV exposure.

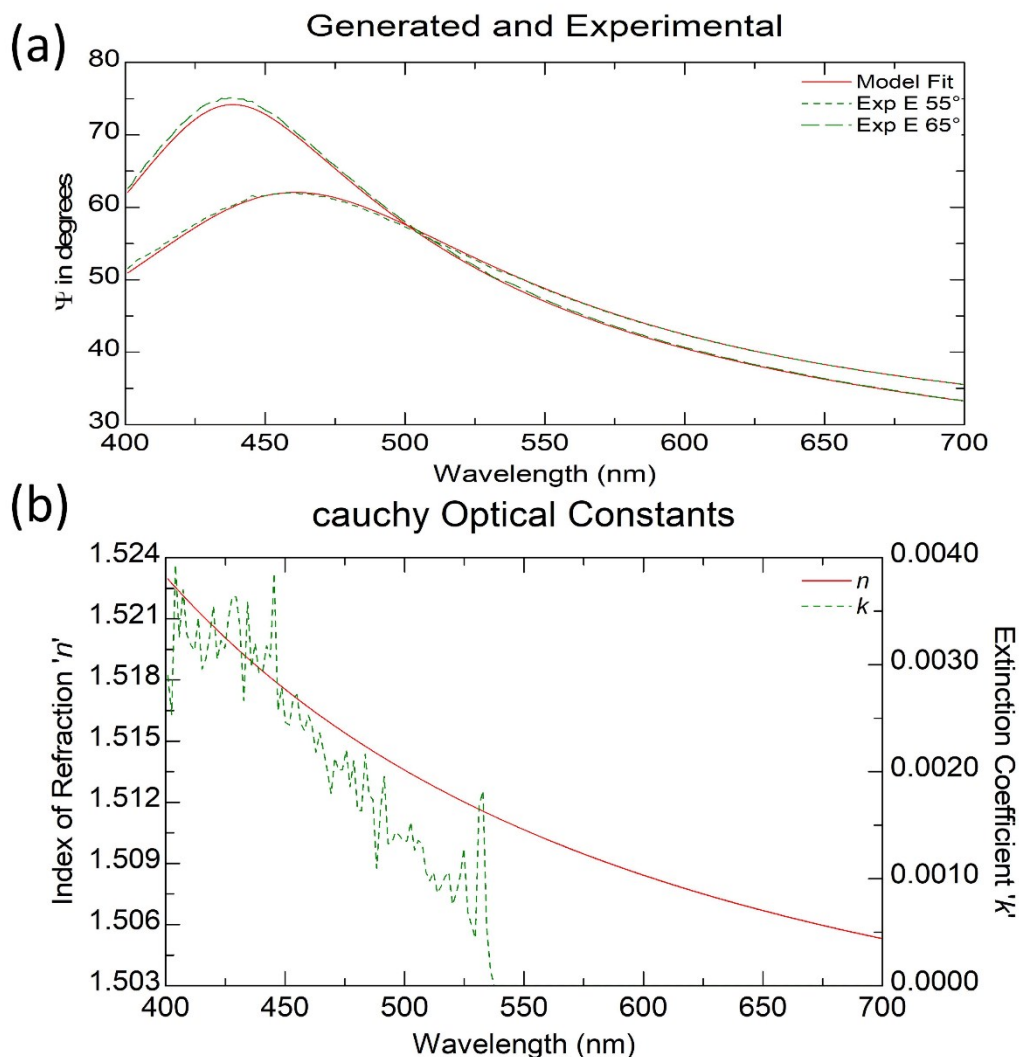


Fig. S5 (a) Experimental and fitting curve of the ellipsometry measurement, and (b) the calculated refractive index and extinction coefficient of the terpolymer film with the thickness of 70 nm in room temperature in the visible range.

		Ethanol	Acetone	THF	DMF
Health hazards	IDLH(ppm)		20000		3500
	OES-TWA	1000	750	100	10
	OES-STEL		1500	200	20
	Odour Threshold (ppm)	6000	300	30	100
Solvent properties	Solubility parameter	13.4	10.0	9.1	12.1
	Dipole (D)	1.7	2.9	1.75	3.8
	Dielectric constant (20°C)	22.4	20.6	7.6	36.7
	Polarity (water 100)	65.4	35.5	21	40.4
	Absolute viscosity	1.08	0.33	0.55	0.82
	Refractive index (20°C)	1.359	1.357	1.404	1.427

Fig. S6 Table of the constants relevant of the hazardous organic solvents tested.

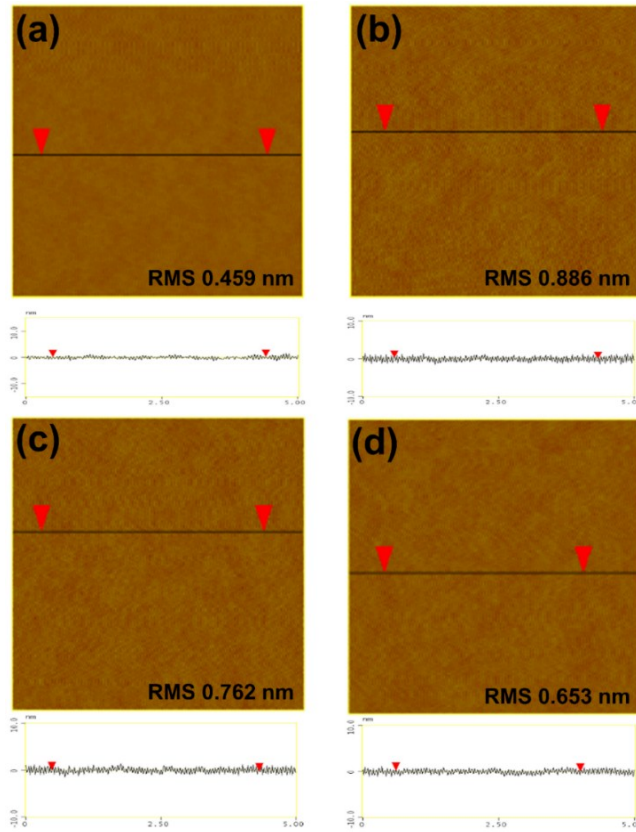


Fig. S7 AFM images and line profiles of single polymer layers spin coated on Si substrate at 2500 rpm. (a) Polymer-1 before UV exposure, (b) Polymer-1 after UV exposure, (c) Polymer-2 before UV exposure, and (d) Polymer-2 after UV exposure.

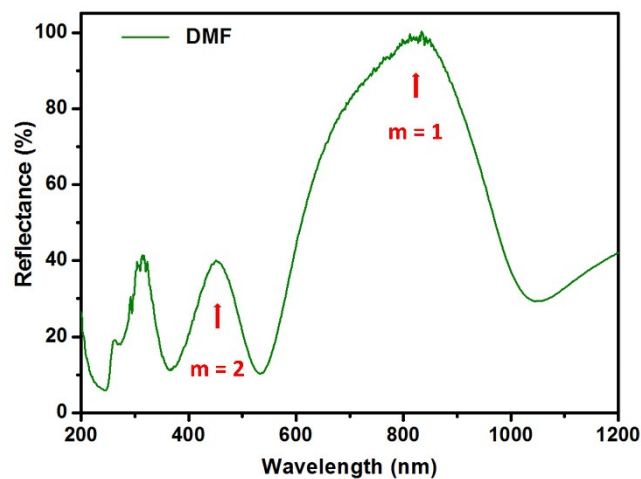


Fig. S8 Reflectance spectrum of the film sensor in DMF solvent in the wavelength range between 200 nm and 1200nm.

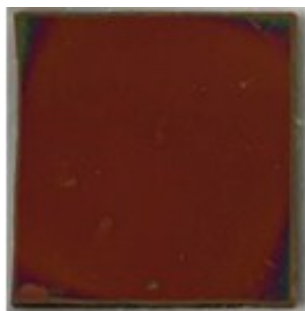


Fig. S9 The optical photo of the etalon film in acetone after 25 cycles of repetitive testing.

Video-1



EtOH
response.avi

Video-2



After EtOH
response.avi