Supporting Information

Crack Blunting and Advancing Behaviors of Tough and Self-healing Polyampholyte Hydrogel

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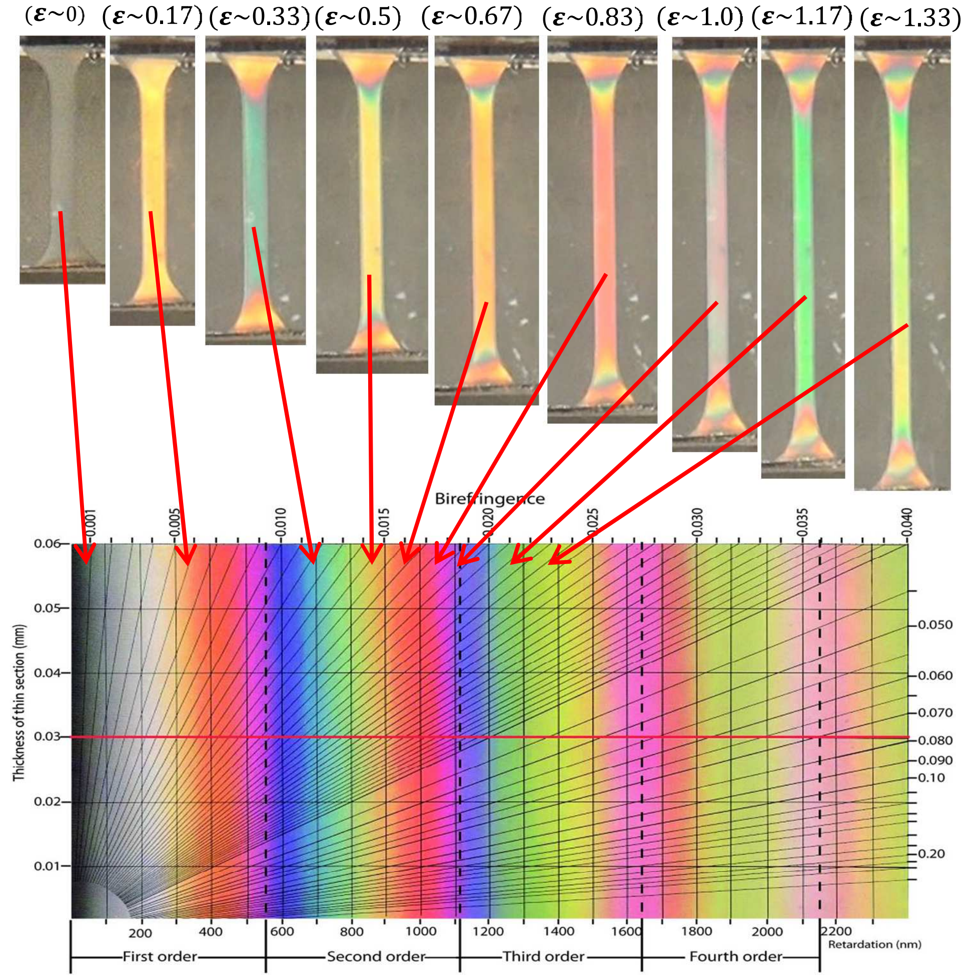
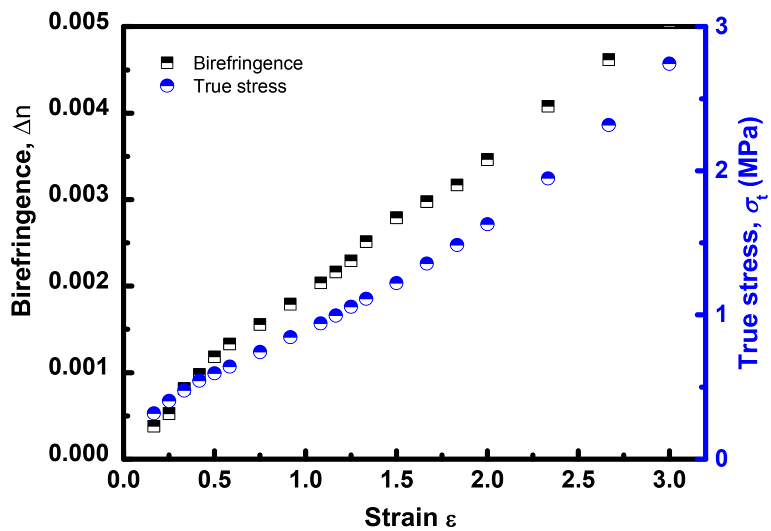
(a)



$(\varepsilon\sim0)$ $(\varepsilon\sim0.17)$ $(\varepsilon\sim0.33)$ $(\varepsilon\sim0.5)$ $(\varepsilon\sim0.67)$ $(\varepsilon\sim0.83)$ $(\varepsilon\sim1.0)$ $(\varepsilon\sim1.17)$ $(\varepsilon\sim1.33)$
Birefringence
Thickness of thin section (mm)
Retardation (nm)
First order
Second order
Third order
Fourth order

(b)



Birefringence
True stress
Birefringence, Δn
True stress, σ_t (MPa)
Strain ε

(c)

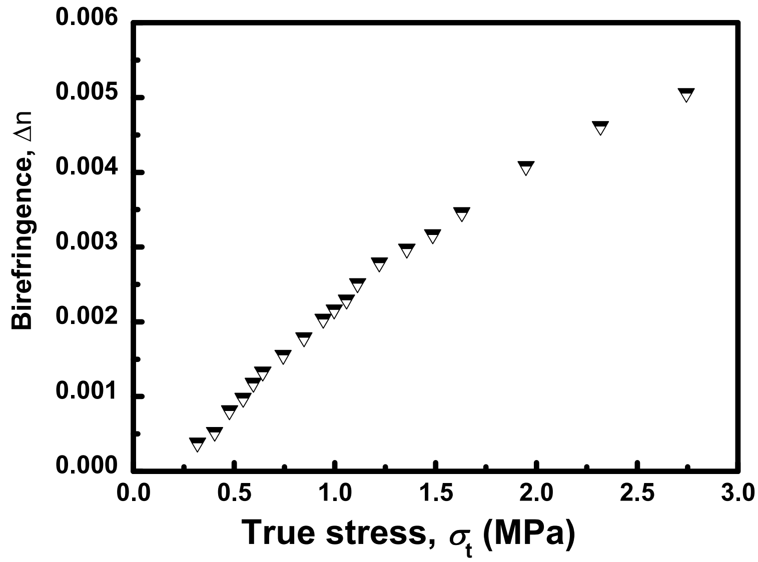
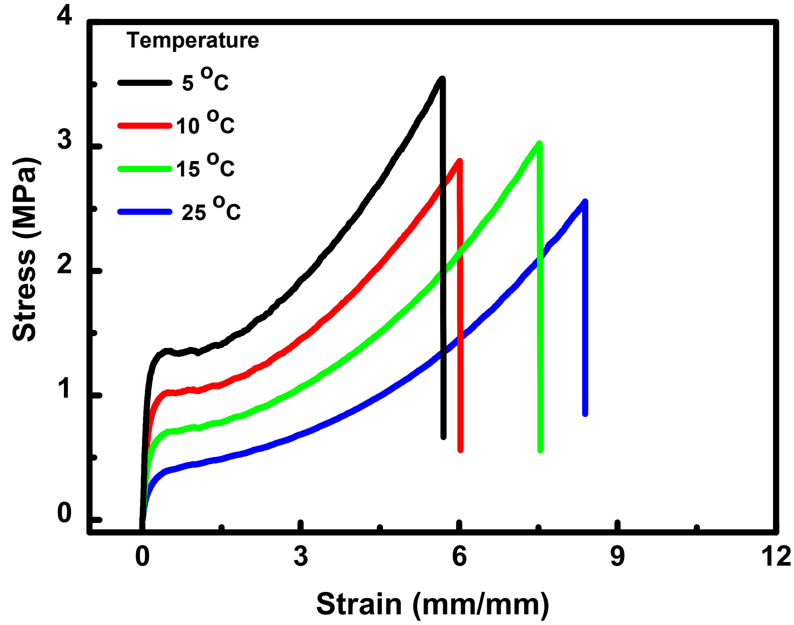


Figure S1. (a) Typical photographs taken under circular polarizer at selected strains for the polyampholyte hydrogel stretched at $\dot{\varepsilon}$ =0.14 s^{-1}, the bottom is the Michel-Levy chart; (b) The birefringence (Δn) and true stress (σ_t) as a function of strain (ε) for the sample stretched at $\dot{\varepsilon}$ =0.14 s^{-1}; (c) The birefringence (Δn) as a function of true stress (σ_t) for the sample stretched at $\dot{\varepsilon}$ =0.14 s^{-1}.

(a)



(b)

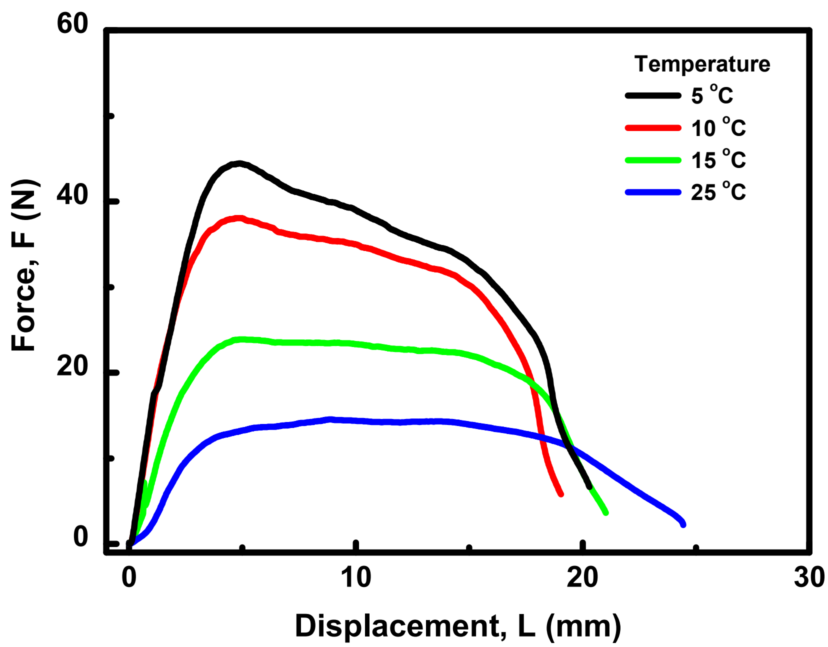


Figure S2. Behaviors of the polyampholyte hydrogel at various temperatures and at a fixed stretch rate of 0.2 s^{-1}. (a) Tensile stress−strain curves; (b) Force *vs* displacement curves for the single edge notched sample.

(a)

(b)

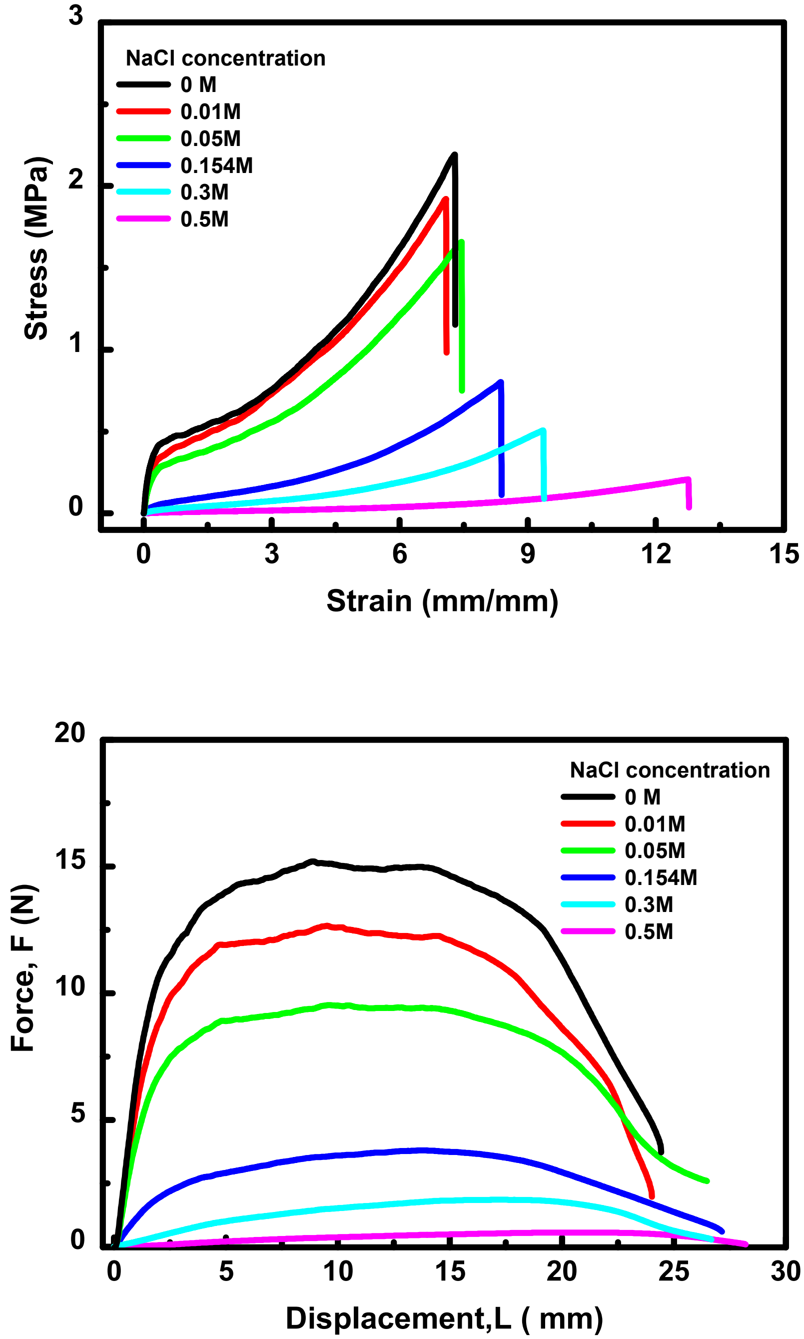


Figure S3. Behaviors of the polyampholyte hydrogel in various NaCl concentrations and at a fixed stretch rate of 0.2 s^{-1}. (a) Tensile stress–strain curves; (b) Force *vs* displacement curves for the single edge notched sample.

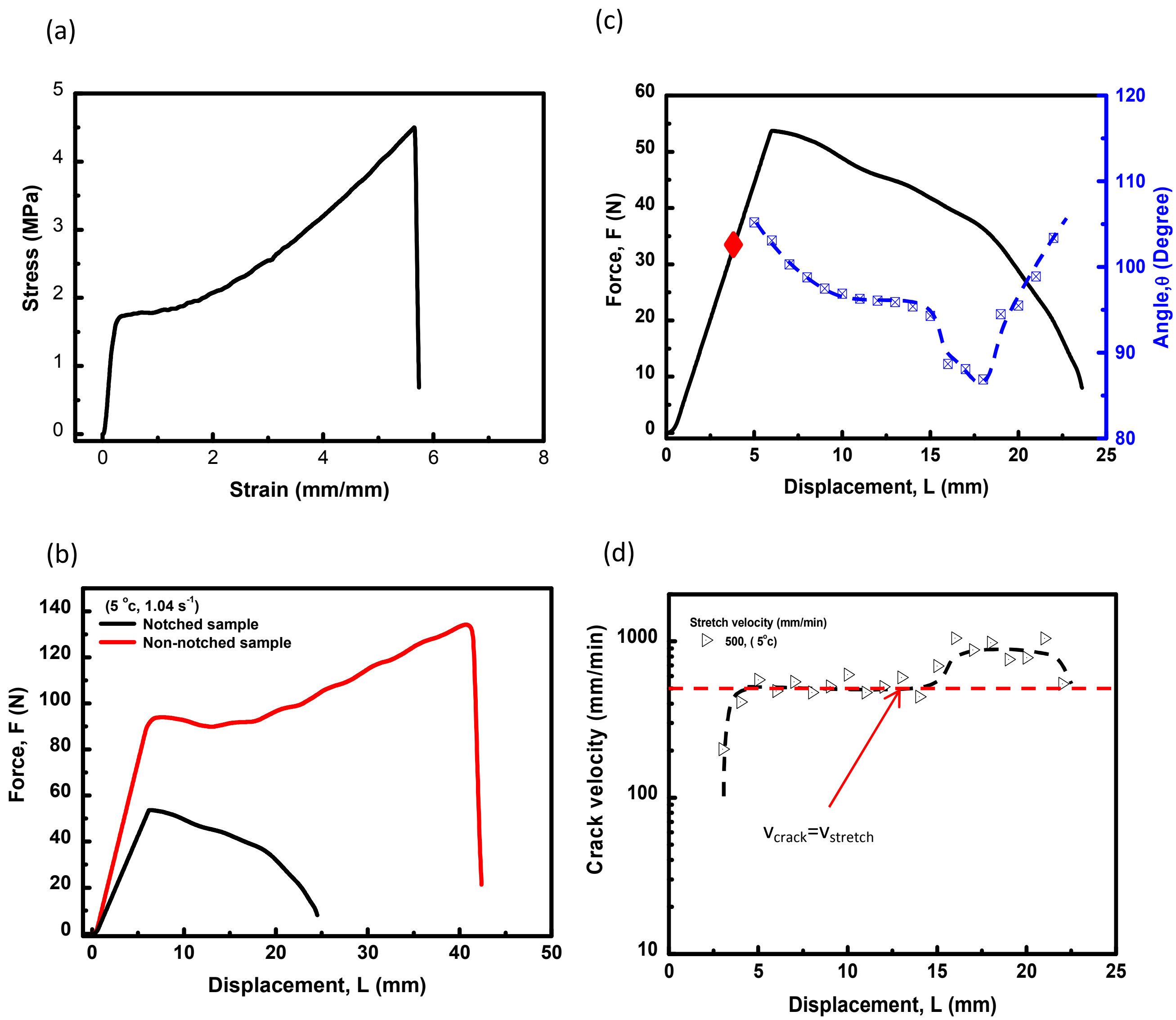


Figure S4. Behaviors of the polyampholyte hydrogel tested at 500mm/min (stretch rates 1.04 s^{-1}) and 5°C. (a) Tensile stress−strain curves; (b) Force *vs* displacement curves for both notched and non-notched samples; (c) The force curve of the notched sample and the angle θ of crack tip during crack advance. The critical point for the starting of crack advancing is marked on the curve by the diamond square; (d) the crack advancing velocity during crack growth. The red dashed line corresponds to the stretch velocity 500mm/min.

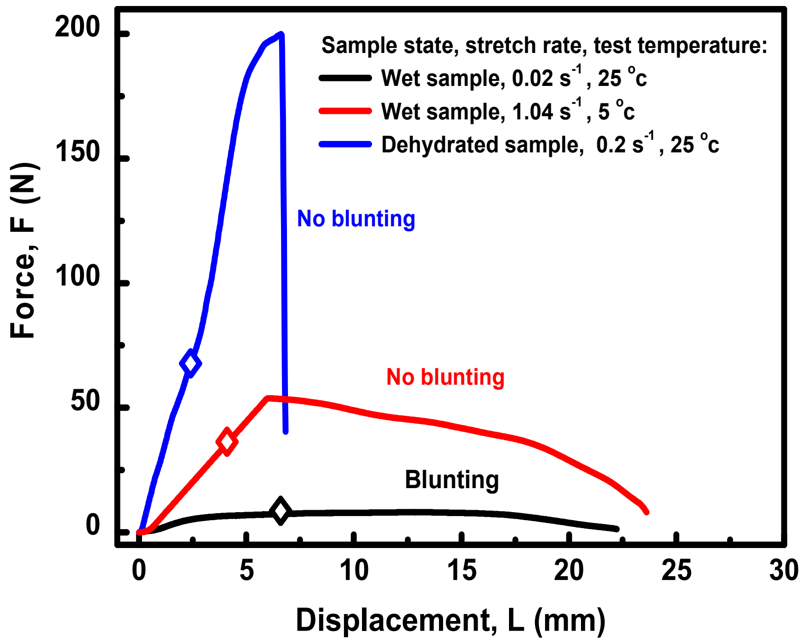


Figure S5. Comparison of force-displacement curves for notched sample in various states. Blue curve: in rigid and brittle state (dehydrated to 26 wt% water content, stretch rate 0.2 s^{-1} and temperature 25°C); Red curve: In rigid and ductile state (52 wt% water content, stretch rate 1.04$s^{-1}$and temperature 5°C); Black curve: In soft and ductile state (52 wt% water content, stretch rate 0.02s^{-1} and temperature 25°C). The black curve is the same curve in **Figure 4a**. The critical points of crack growth are marked on each curve by the diamond square.

Movie S1. *In-situ* recording video during tensile test of the polyampholyte hydrogel at $\dot{\varepsilon}$ = 0.14 s^{-1} (v=100 mm/min).

Movie S2. *In-situ* recording video during the pure shear test of the single-edge-notched polyampholyte hydrogel at $\dot{\varepsilon}$ = 0.02 s^{-1} (v=10 mm/min). Video is replayed five times of the real speed.

Movie S3. *In-situ* recording video during pure shear test of the single-edge-notched polyampholyte hydrogel at high stretch rate ($\dot{\varepsilon}$ = 1.04 s^{-1}) and low temperature (5°C). No blunting occurred at this condition. Video is replayed 1/8 times of the real speed.

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