Electronic Supplementary Material (ESI) for Soft Matter.

Microrheological characterization of covalent adaptable hydrogels for applications in oral delivery†

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1 Supporting Information

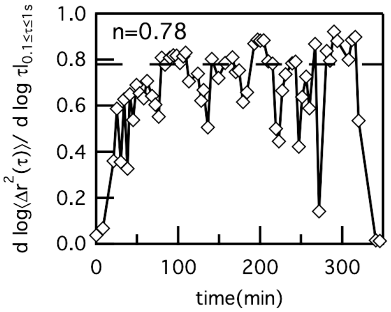

Fig. S1 Control experiments of CAH degradation measured in a petri dish sample chamber. The logarithmic slope of the mean-squared displacement (MSD), $\alpha = \frac{d\log\langle\Delta r^2(\tau)\rangle}{d\log\tau}$, as function of time during degradation at pH 4.3. The dashed line is the phase transition defined by the critical relaxation exponent, n. The value of n is $n = 0.78 \pm 0.08$ which is determined using time-cure superposition.

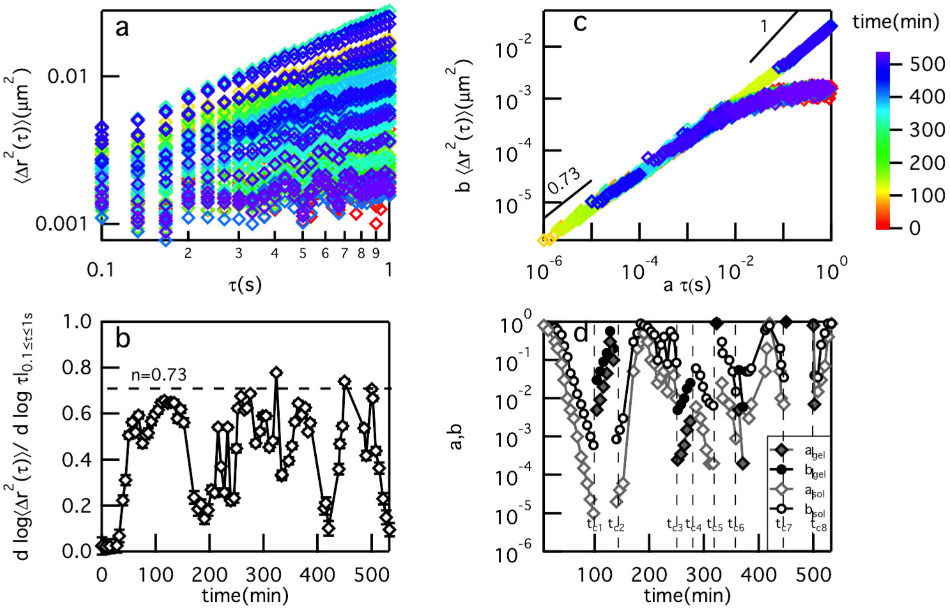

Fig. S2 μ^2rheology measurements of CAH degradation at a single pH, pH 4.3. (a) The measured MSD and (b) the logarithmic slope of the MSD, $\alpha = \frac{d\log\langle\Delta r^2(\tau)\rangle}{d\log\tau}$, as a function of degradation time. The dashed line is the phase transition, which is quantitively determined by the critical relaxation exponent, n. (c) Using time-cure superposition the measured MSDs are shifted into sol and gel master curves. (d) The shift factors diverge at each critical degradation time, which are $t_{c,1}$=100 mins, $t_{c,2}$=137 mins, $t_{c,3}$=250 mins, $t_{c,4}$=322 mins, $t_{c,5}$=360 mins, $t_{c,6}$=374 mins, $t_{c,7}$=449 mins and $t_{c,8}$=503 mins.

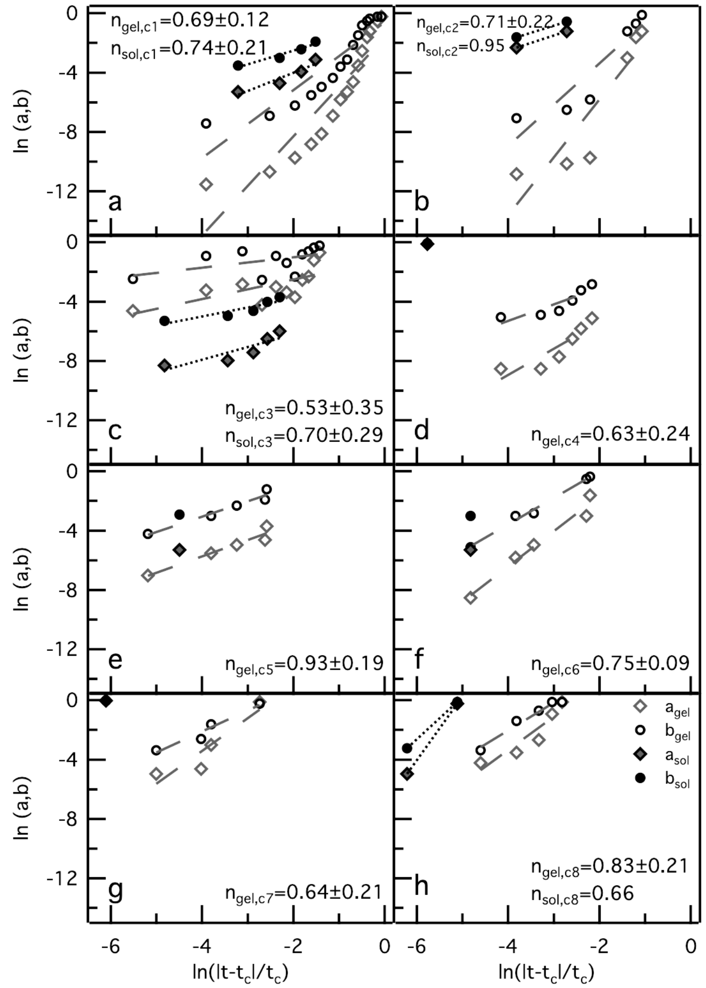

Fig. S3 TCS of μ^2rheology measurements in acidic buffer solution (pH=4.3). The critical relaxation exponent is calculated from shift factors for each phase transition, here five gel-sol and three sol-gel transitions are shown in (e)$-$(l) with their corresponding values of n.

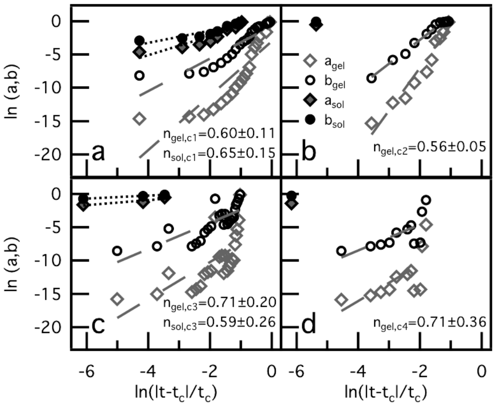

Fig. S4 TCS for consecutive degradation at pH 7.4 and then at pH 4.3. The critical relaxation exponents, n, are determined by fitting the logarithm of the shift factors a and b versus the logarithm of the distance away from the critical degradation time, t_c. The n value is reported for each phase transition, two gel-sol and two sol-gel transitions are shown in (a)$-$(d).

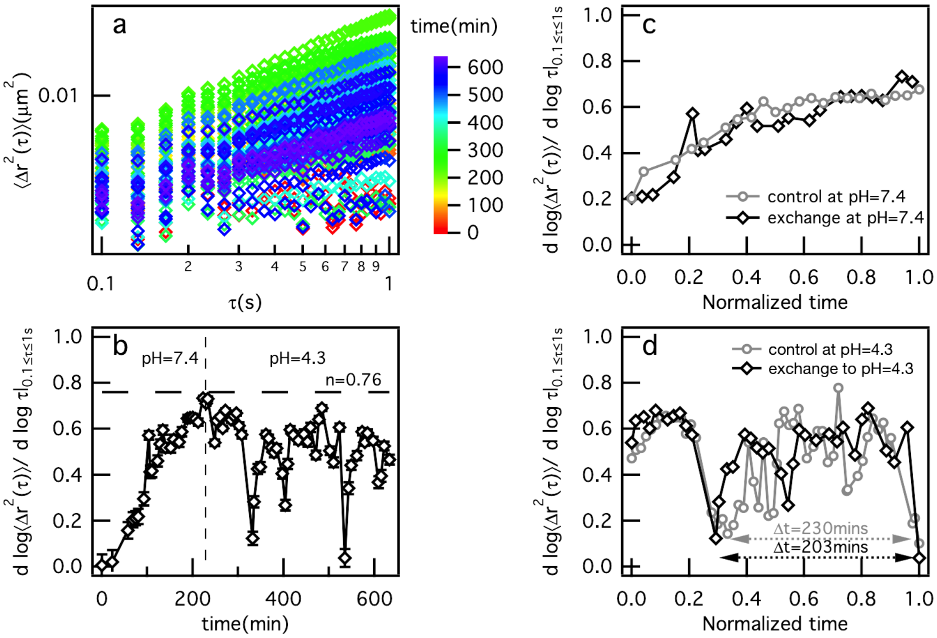

Fig. S5 Consecutive CAH degradation at pH 7.4 and then at pH 4.3. (a) The measured mean-squared displacement verse lag time, the color represents the degradation time. (b) The logarithmic slope of the MSD versus degradation time. The vertical dotted line represents the time when the buffer is exchanged from physiological to acidic pH. The horizontal dashed line is the n value which indicates the phase transition. This value is determined using time-cure superposition. The evolution of material properties are compared for consecutive and single degradation experiments at (c) physiological and (d) acidic degradation. (d) In acidic degradation the time of a degradation-gelation cycle is $\Delta t = 230$ mins for a single degradation experiment and $\Delta t = 203$ mins for a consecutive degradation experiment.

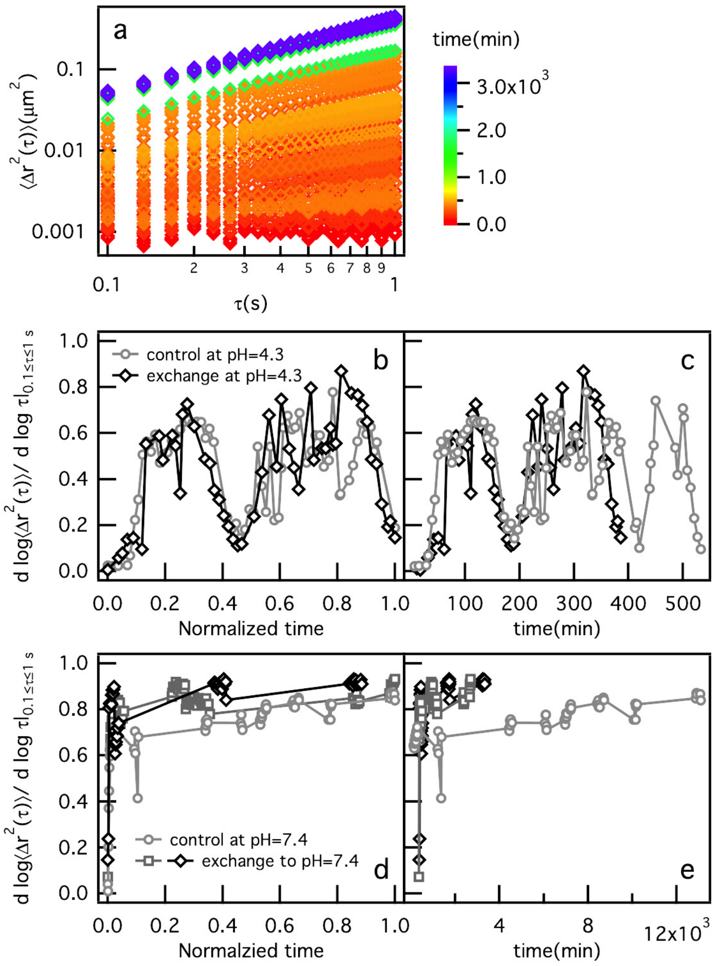

Fig. S6 Consecutive degradation first at pH 4.3 and then pH 7.4. (a) The measured mean-squared displacement verse lag time, the color represents the degradation time. The comparison of single and consecutive degradation experiments at (b)−(c) acidic and (d)−(e) physiological pHs. The logarithmic slope of the MSD is plotted versus (b) and (d) normalized time and (c) and (e) degradation time. The evolution of the material properties does not change between these experiments. The time scale of degradation at acidic pH remains the same but degradation at pH 7.4 is accelerated in this degradation scheme.

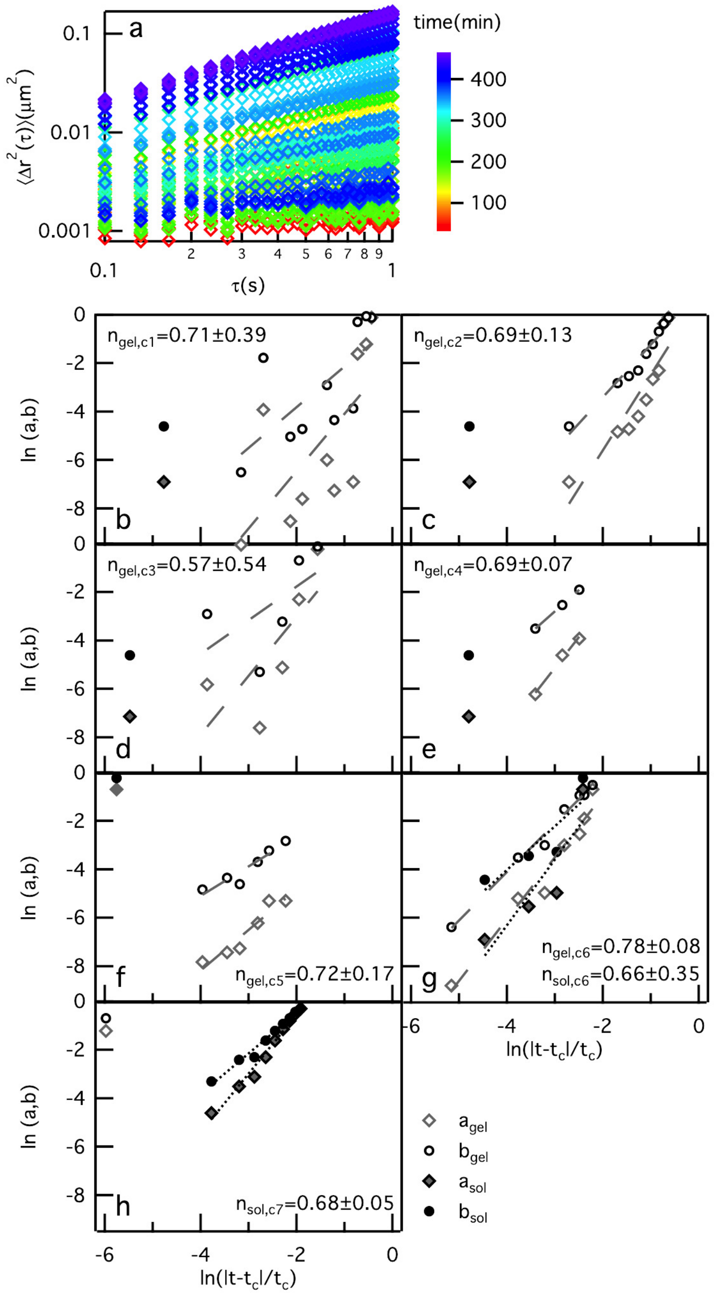

Fig. S7 Consecutive degradation first at pH 4.3 and then pH 7.4. (a) The measured MSDs in the first 24 hrs of the experiment, the color represents the degradation time. Critical relaxation exponents, n, are reported for each phase transition, which are four gel-sol and three sol-gel transitions, which are shown in (b) through (h).

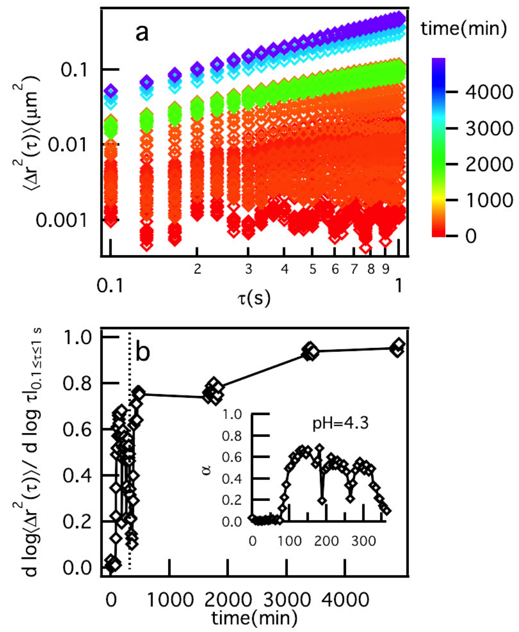

Fig. S8 Consecutive degradation first at acidic then physiological conditions. (a) The measured mean-squared displacement versus the lag time, the color represents the degradation time. (b) The change in $\alpha = \frac{d\log\langle\Delta r^2(\tau)\rangle}{d\log\tau}$ as a function of degradation time throughout the experiment. The inset shows the degradation at acidic pH.

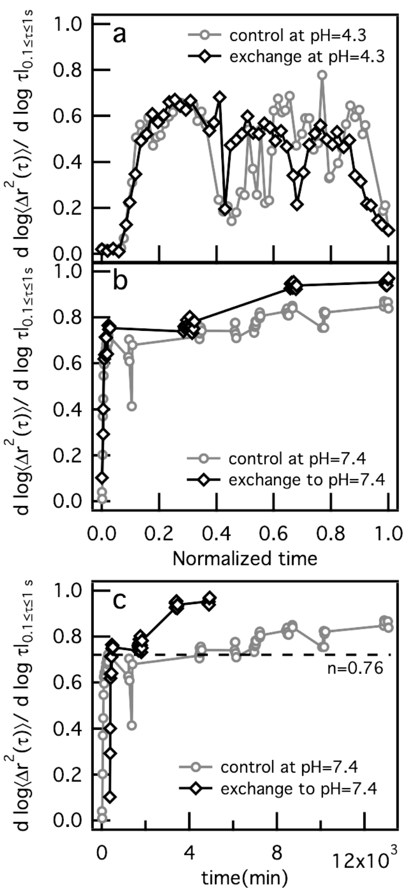

Fig. S9 Comparison of consecutive degradation first at acidic then physiological conditions and single pH experiments at (a) pH 4.3 and (b) pH 7.4. These graphs show no change in the material property evolution measured with the logarithmic slope of the MSD. (c) Comparison of the logarithmic slope of the MSD as a function of degradation time at pH 7.4. This results shows the acceleration of degradation at pH 7.4 in a material that is first degraded at pH 4.3.