Supplementary information for

Role of soft-gel substrates on bouncing-merging transition in drop impact on liquid film

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Table S1. PAAm composition information with five different wt% of crosslinker.

C_{BIS} (wt%)[1]	$C_{Monomer}$(wt%)[2]	*TEMED(%)*[3]	C_{APS}(%)[4]	*Vol% of APS in sample*[5]
1.5	*4.69*	*0.2117*	*11.22*	*0.5*
3.0				
6.0				
10.5				
15.0				

[1] N,N-methylene-bis-acrylamide (BIS) wt%, noted as $C_{BIS}(wt\%)$, is defined as $\left(\frac{w_{BIS}(g)}{w_{monomer}(ml)} \text{ x } 100\right)$

[2] Acrylamide monomer wt% is defined as $C_{monomer}(wt\%) = \left(\frac{w_{monomer}(g)}{w_{H_2O}(ml)} \text{ x } 100\right)$, where deionized water was used.

[3] TEMED(%) is $\left(\frac{Vol_{TEMED}}{Vol_{batch}} \text{ x } 100\right)$, where the volume of the batch is the volume of premixed solution of monomer, BIS, and deionized water.

[4] APS solution was prepared right before it was used and its concentration was defined as $C_{APS}(\%) = \left(\frac{w_{APS}(g)}{w_{H_2O}(ml)} \text{ x } 100\right)$, where deionized water was used.

[5] The true APS(%) used for each sample was constant as 0.5% as similar to vol% of TEMED, defined as $\left(\frac{Vol_{APS}}{Vol_{batch}} \text{ x } 100\right)$.

Swelling ratio of PAAm

Swelling ratio is defined as $\lambda = \frac{D_\infty}{D_0}$, where D_∞ is the diameter of PAAm in the swollen state and D_0 is the diameter of PAAm in the as-prepared state. λ is related to the crosslinking density of PAAm, thus it decreased as a function of C_{BIS} until C_{BIS} = 6.0 wt%, while C_{BIS} > 6.0 wt%, λ became independent of C_{BIS}. This can be explained by the spatial inhomogeneity[1,2] of PAAm that 2nd order crosslinking reactions (*i.e.*, multiple crosslinking reactions[3,4]) become dominant, resulting in nonuniform crosslinking density[5] instead of forming new polymer networks (*i.e.*, crosslinking reactions) that affect λ (Fig. S1).

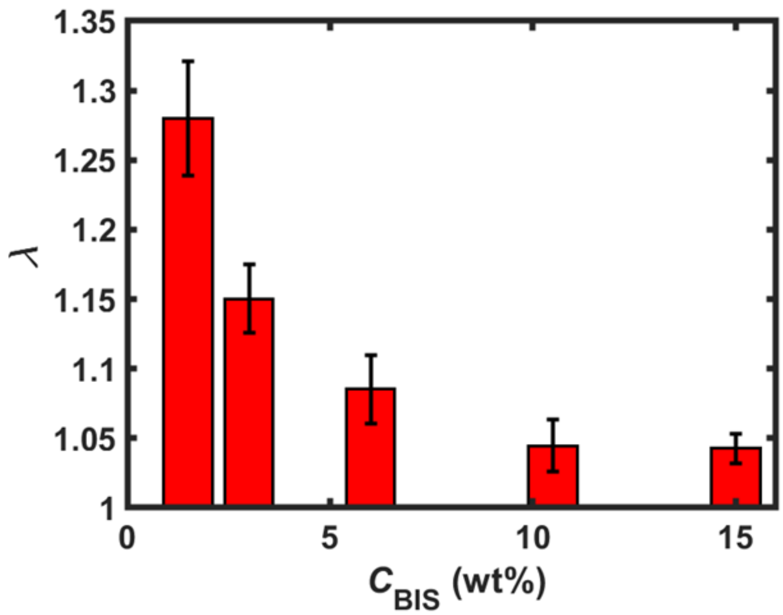

Fig. S1 Swelling ratio (λ) of PAAm with different wt% of C_{BIS}.

Overall droplet regime diagram of PAAm with different C_{BIS} as the soft substrate

We observed no significant difference in We_{cr} (~17) at the transition of bouncing and merging with PAAm substrates prepared by different C_{BIS} since the droplet does not contact with the hydrogel substrate (*i.e.*, hydrogel substrate does not affect the droplet effect) for the merging in the inertial limit. On the other hand, we obtained the critical changes in H^*_{DT}, H^* for the deformation transition (*i.e.*, transition from bouncing to late merging), with PAAm substrates with different C_{BIS}. From Fig. S2, PAAm with 1.5 to 6.0 wt% C_{BIS} showed increases in H^*_{DT}, leading the late merging phenomena to occur with higher H^*. As described in the manuscript (Fig. 7b), when Y increases, deformation of droplet increases thus film thickness(H^*) also increases to reach $\Delta SE_F \geq \Delta SE_D$ (Fig. S2).

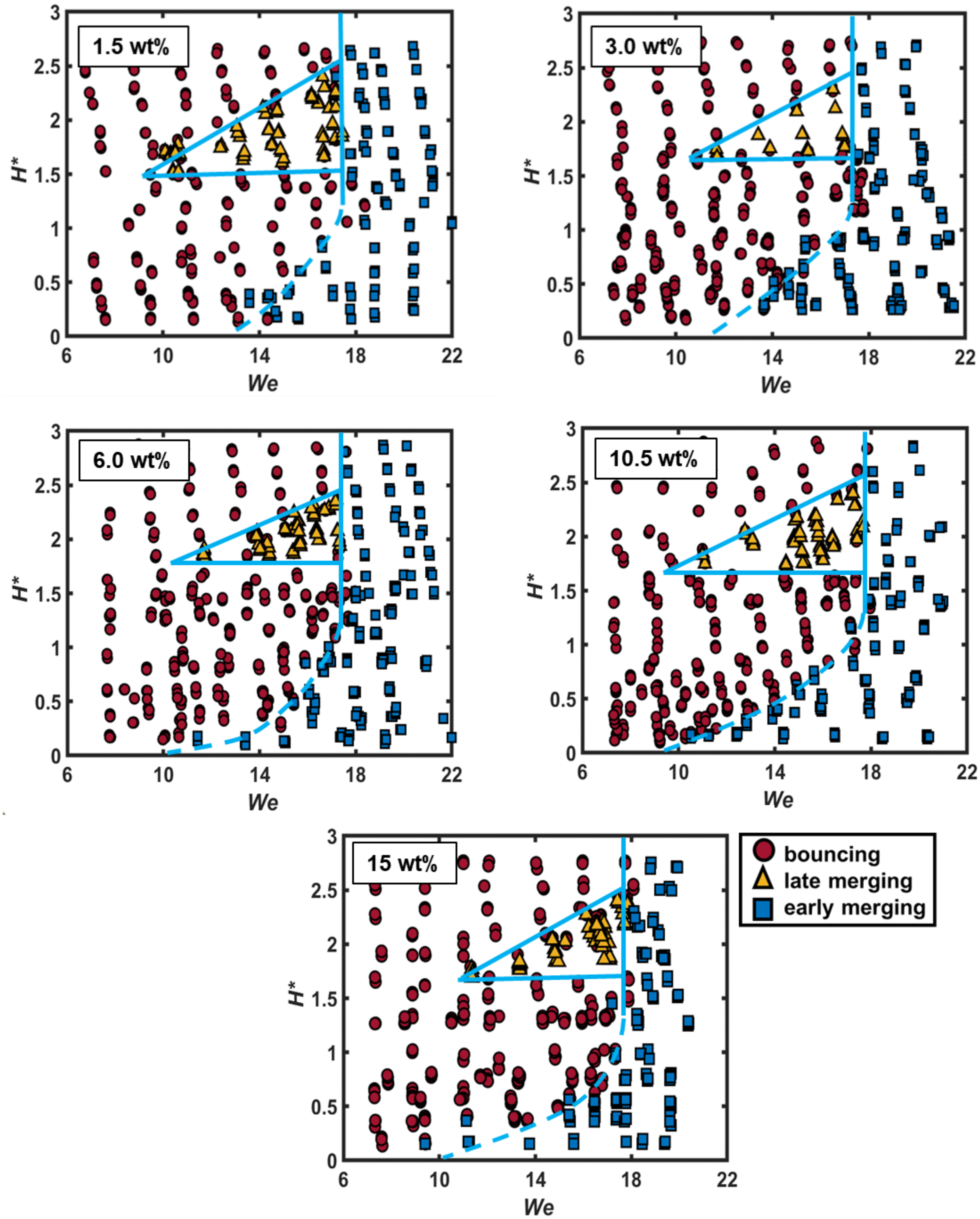

Fig. S2 Overall regime diagrams of PAAm with five different C_{BIS} (1.5, 3.0, 6.0, 10.5, and 15 wt%) as the soft substrate.

References

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