

# Supplementary Material

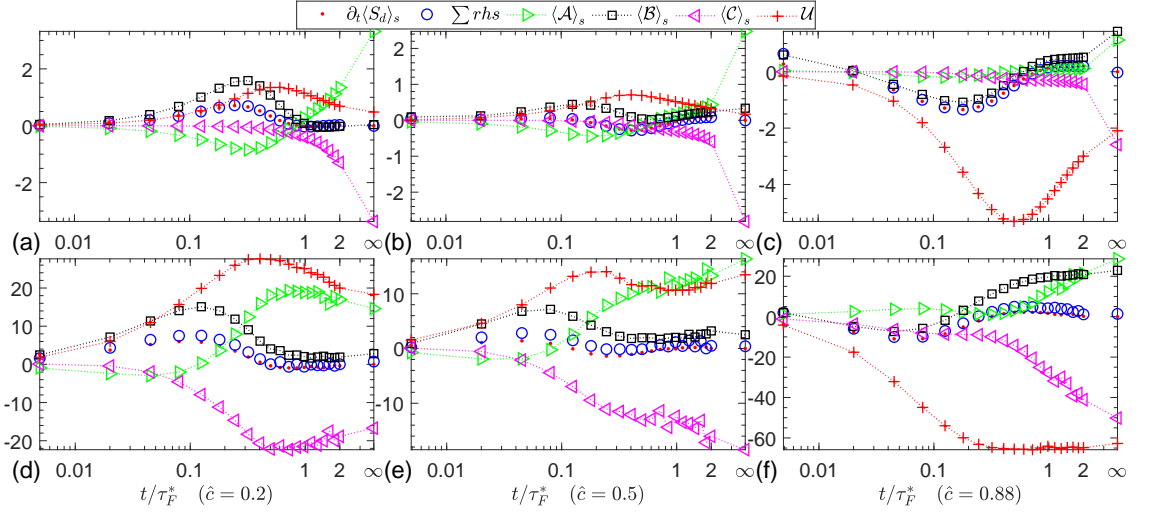


FIGURE S1. The time-dependent of lhs term, rhs terms and their sum in (2.24) with  $\phi = S_d$  for constant-density cases A (first row) and B (second row) conditioned at three representative reaction zone at  $\hat{c} = 0.2, 0.5$  and  $0.88$  (left to right columns). All terms are normalized based on a length unit of  $\delta_F$ , a speed unit of  $S_L$  and a density unit of  $\rho_u$ .

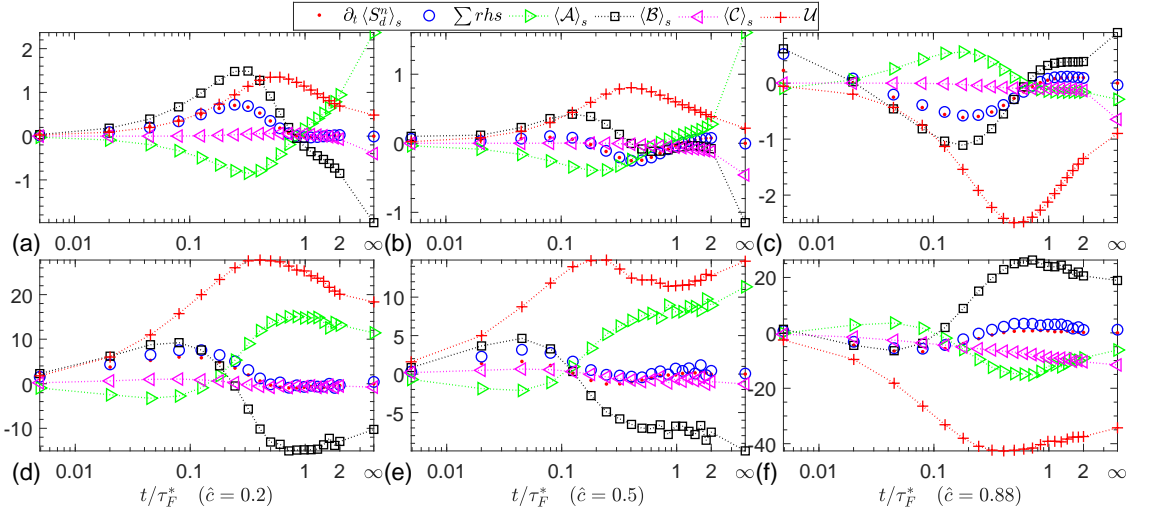


FIGURE S2. Time-dependent terms in (2.24) with  $\phi = S_d^n$  (i.e normal diffusion contribution to displacement speed) similarly plotted as in figure S1.

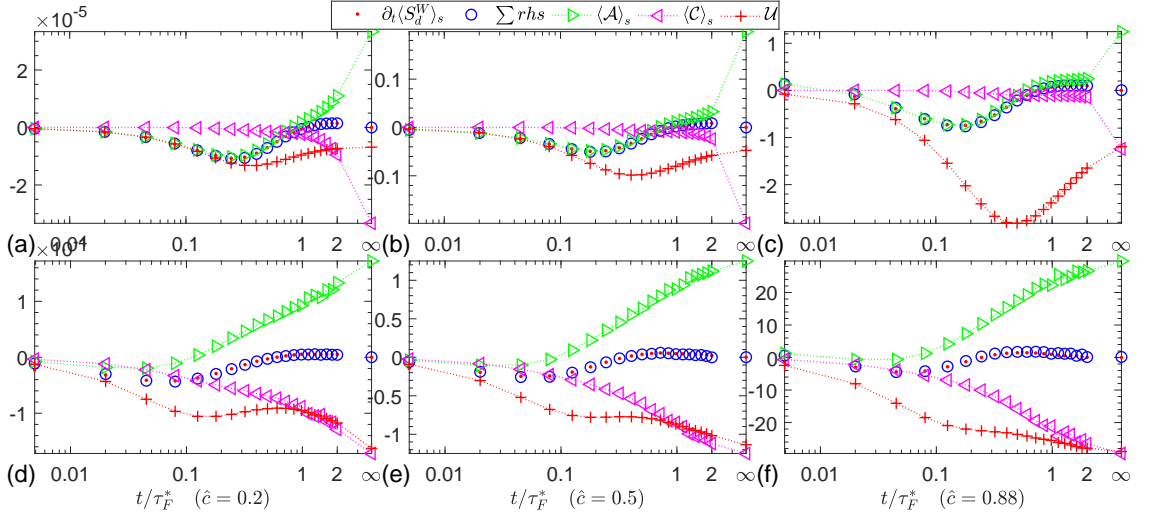


FIGURE S3. Time-dependent terms in (2.24) for  $\phi = S_d^W$  (reaction contribution to displacement speed) similarly plotted as figure S1.

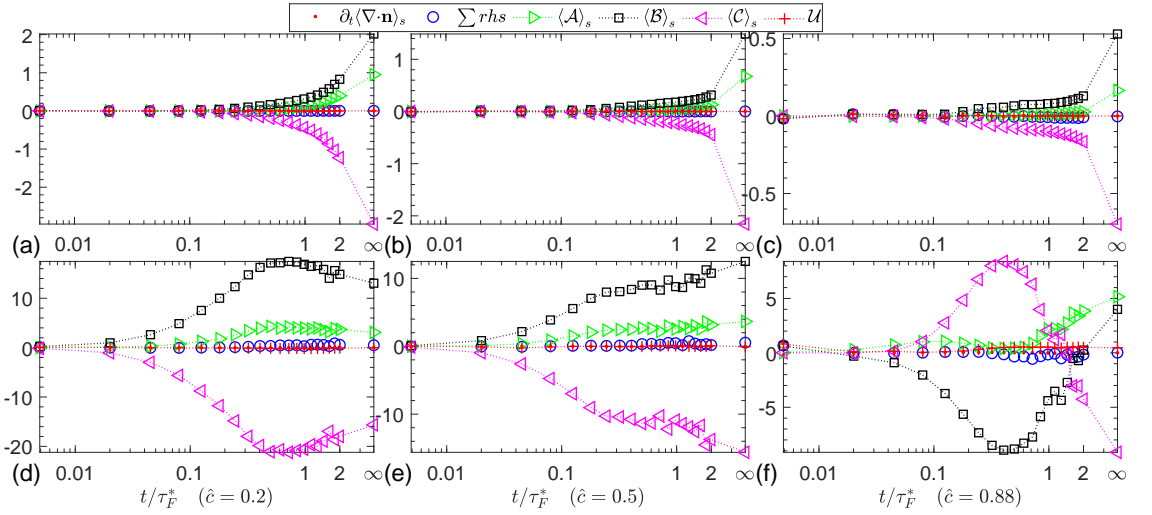


FIGURE S4. Time-dependent terms in (2.24) with  $\phi = \nabla \cdot \mathbf{n}$  (curvature) similarly plotted as in figure S1.

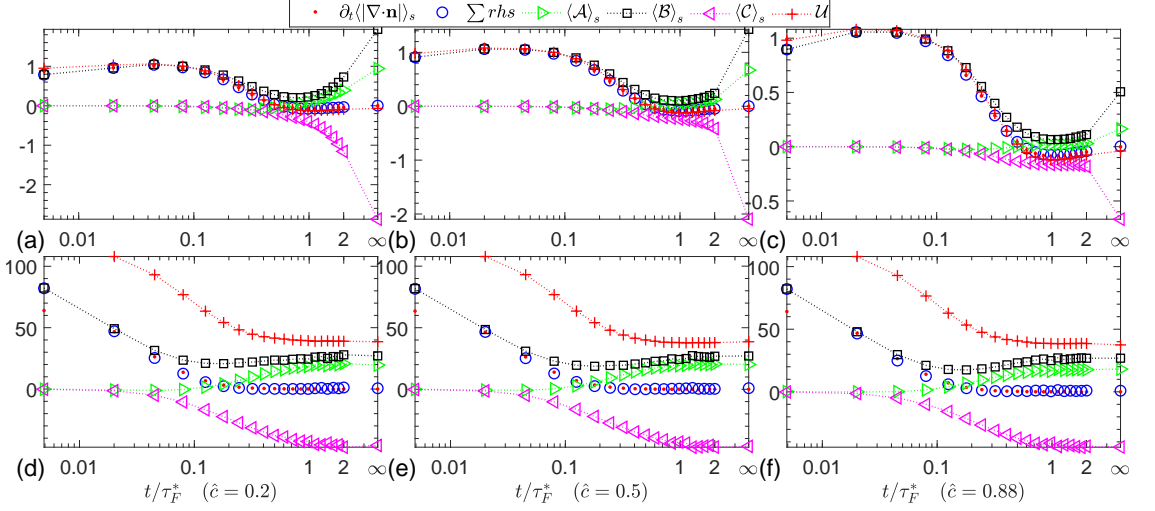


FIGURE S5. Time-dependent terms in (2.24) for  $\phi = |\nabla \cdot \mathbf{n}|$  (absolute curvature) similarly plotted as in figure S1.

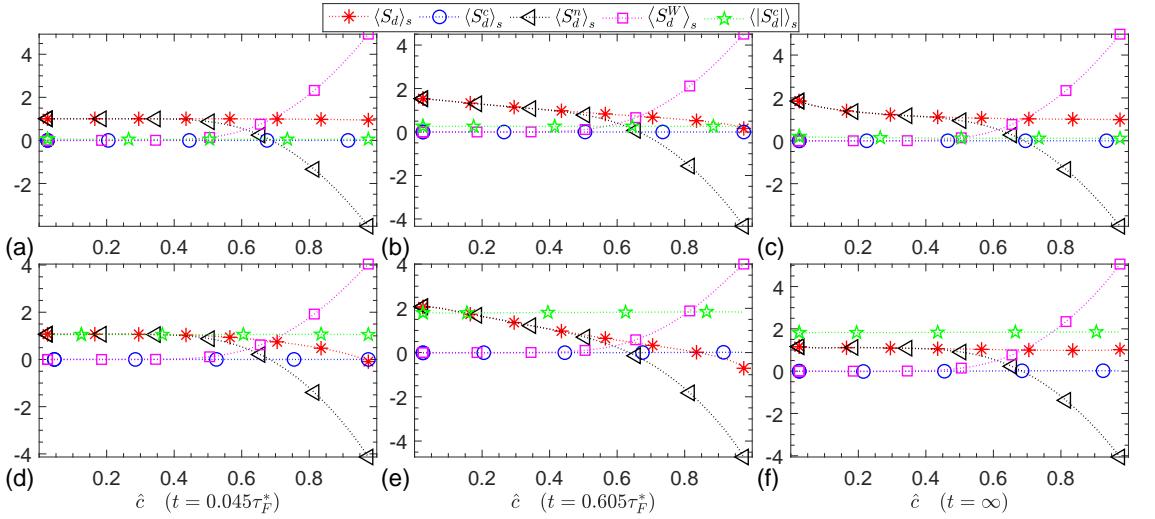


FIGURE S6. The  $\hat{c}$ -dependency of surface-averaged quantities  $\langle \phi \rangle_s|_{\hat{c},t}$  for each of five  $\phi = [S_d, S_d^n, S_d^c, |S_d|, S_d^W]$  conditioned at three representative time instants at  $t/\tau_F^* = 0.045$ ,  $0.605$  and  $\infty$  (left to right columns) for constant case A (top row) and B (bottom). All terms are normalized by  $S_L$

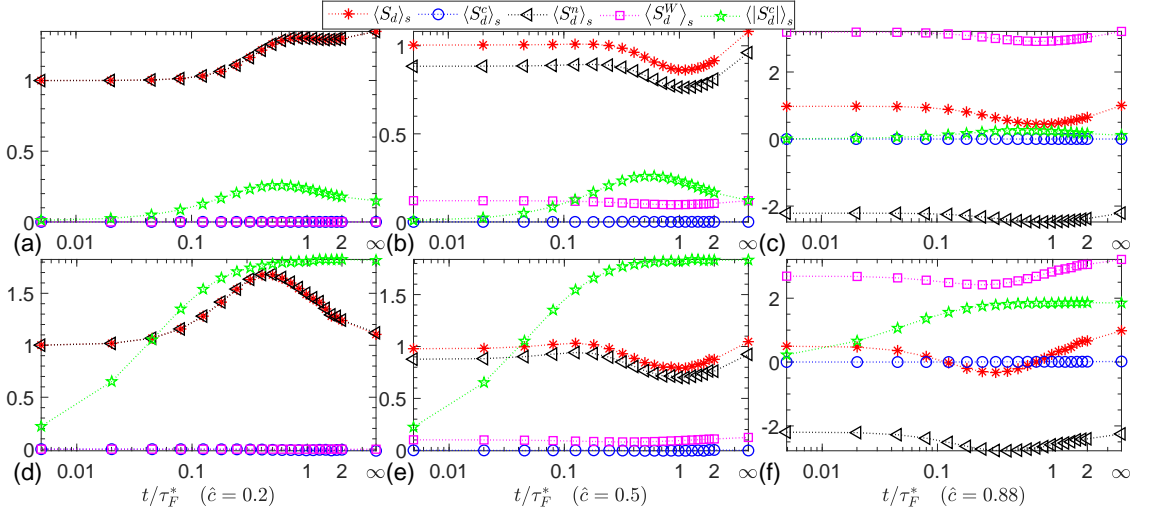


FIGURE S7. The time-dependent of surface-averaged quantities  $\langle \phi \rangle_s|_{\hat{c},t}$  for each of five  $\phi = [S_d, S_d^n, S_d^c, |S_d^c|, S_d^W]$  conditioned at three representative reaction zone at  $\hat{c} = 0.2$ ,  $0.5$  and  $0.88$  (left to right columns) for constant-density case A (top row) and B (bottom). All terms are normalized by  $S_L$ .

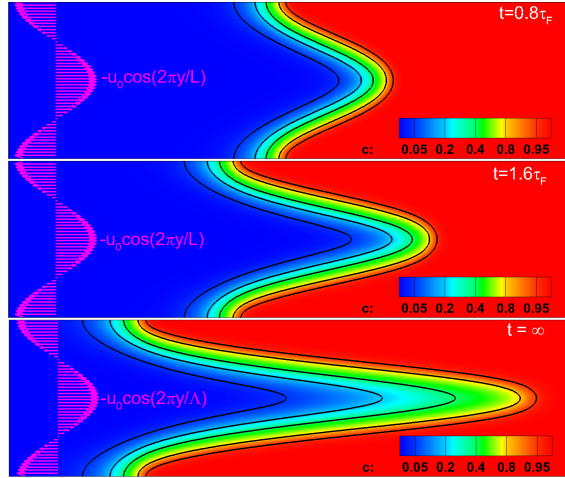


FIGURE S8. Snapshots of the  $c$ -field of in the constant-density case A at two transient instants of (a)  $t = 0.8\tau_F$  and (b)  $1.6\tau_F$  and (c) at the fully-developed state of  $t_\infty$ . Five black lines show iso-surfaces of  $c=0.05, 0.2, 0.4, 0.8$ , and  $0.95$  from left to right.