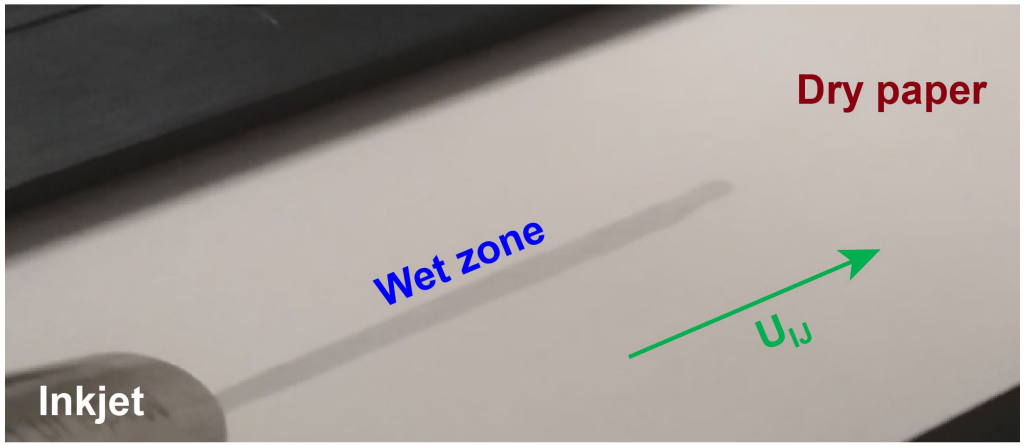
Inkjet printing of surfactant solutions onto thin moving porous media



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Motivation and application area

Inkjet printing for office applications uses water-based inks

Surfactants are standard components to control ink wettability and stability

Goals:

- **Understand role of surfactants during ink imbibition into paper**
- **Develop validated numerical model**

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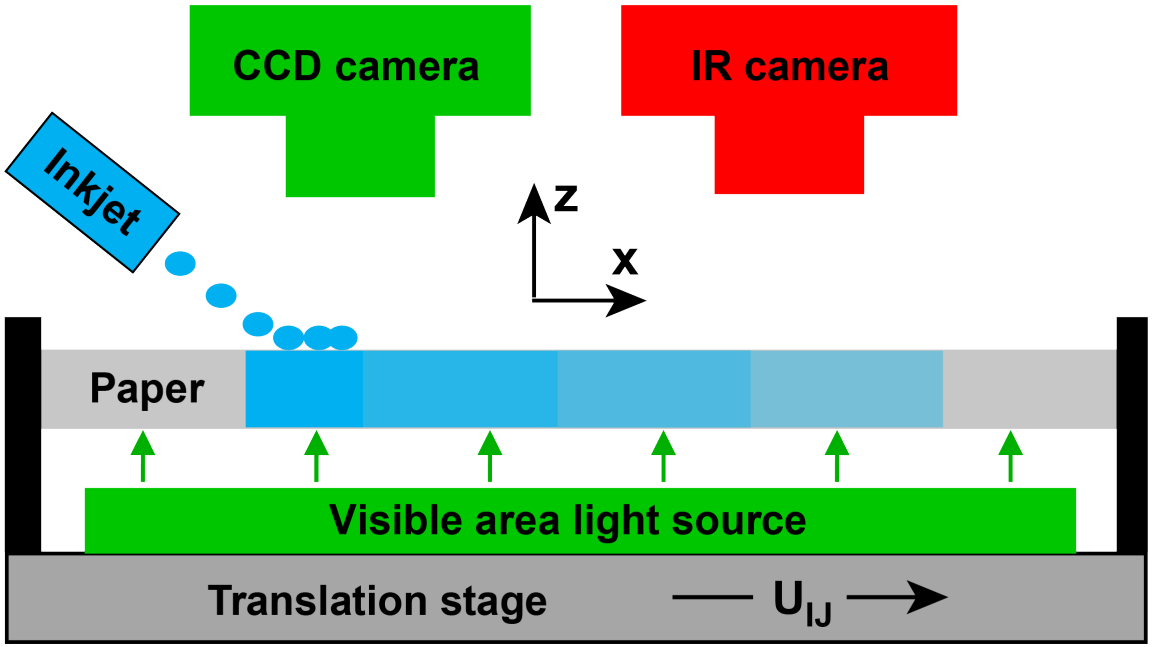
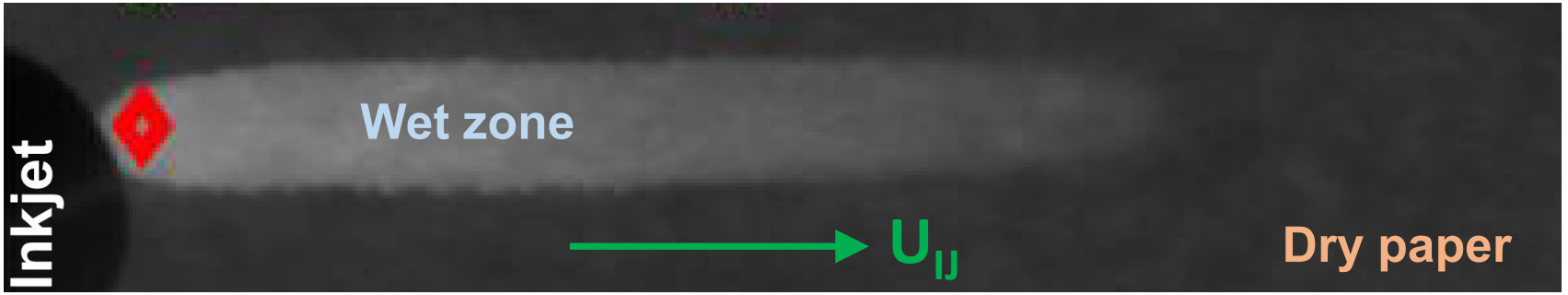
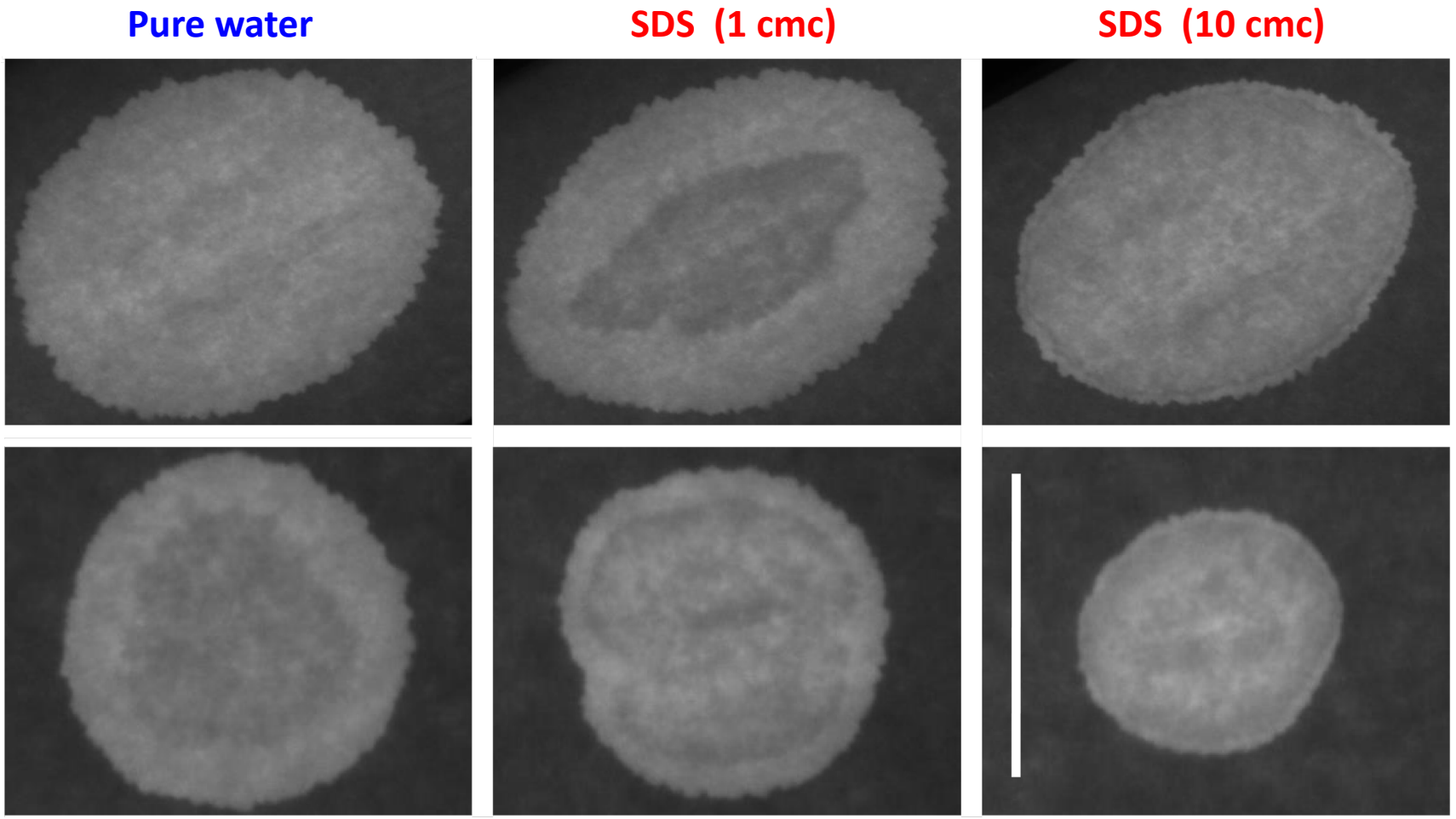
Experimental setup



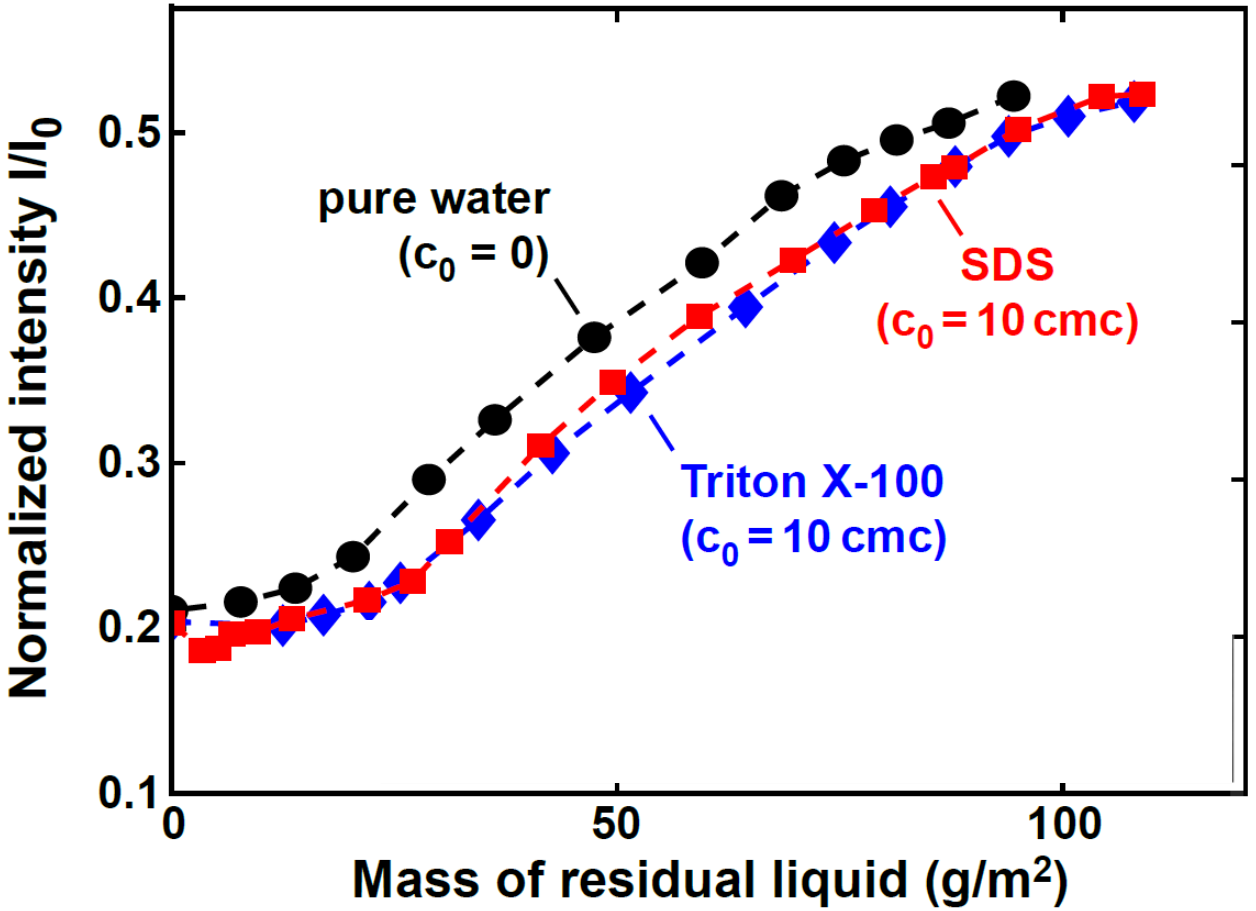


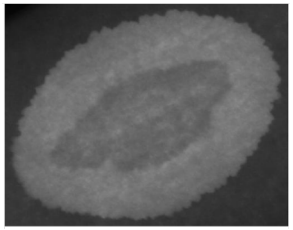
Drop casting experiments



Interpretation of dark regions

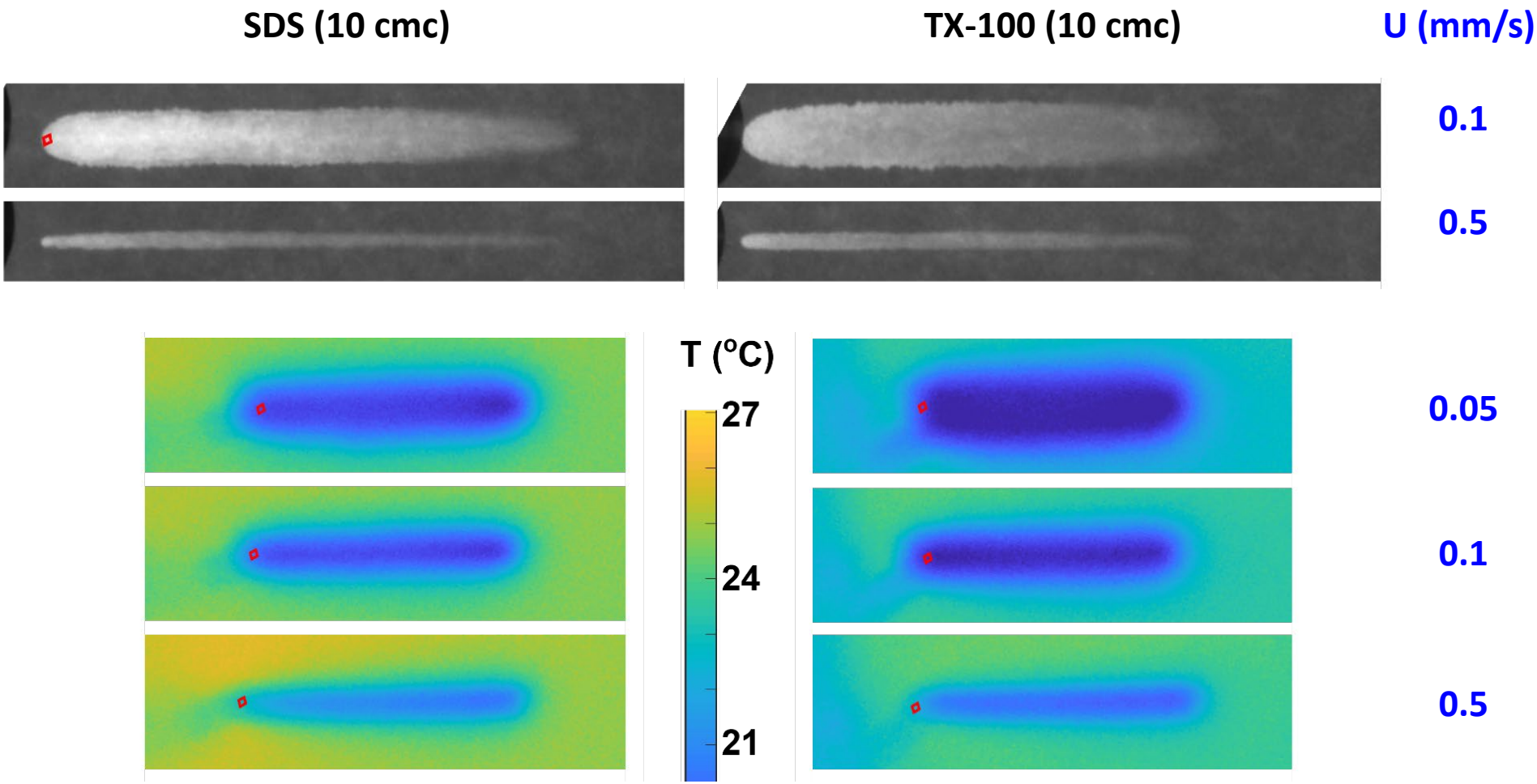
Equilibrium calibration of transmittance vs. liquid content





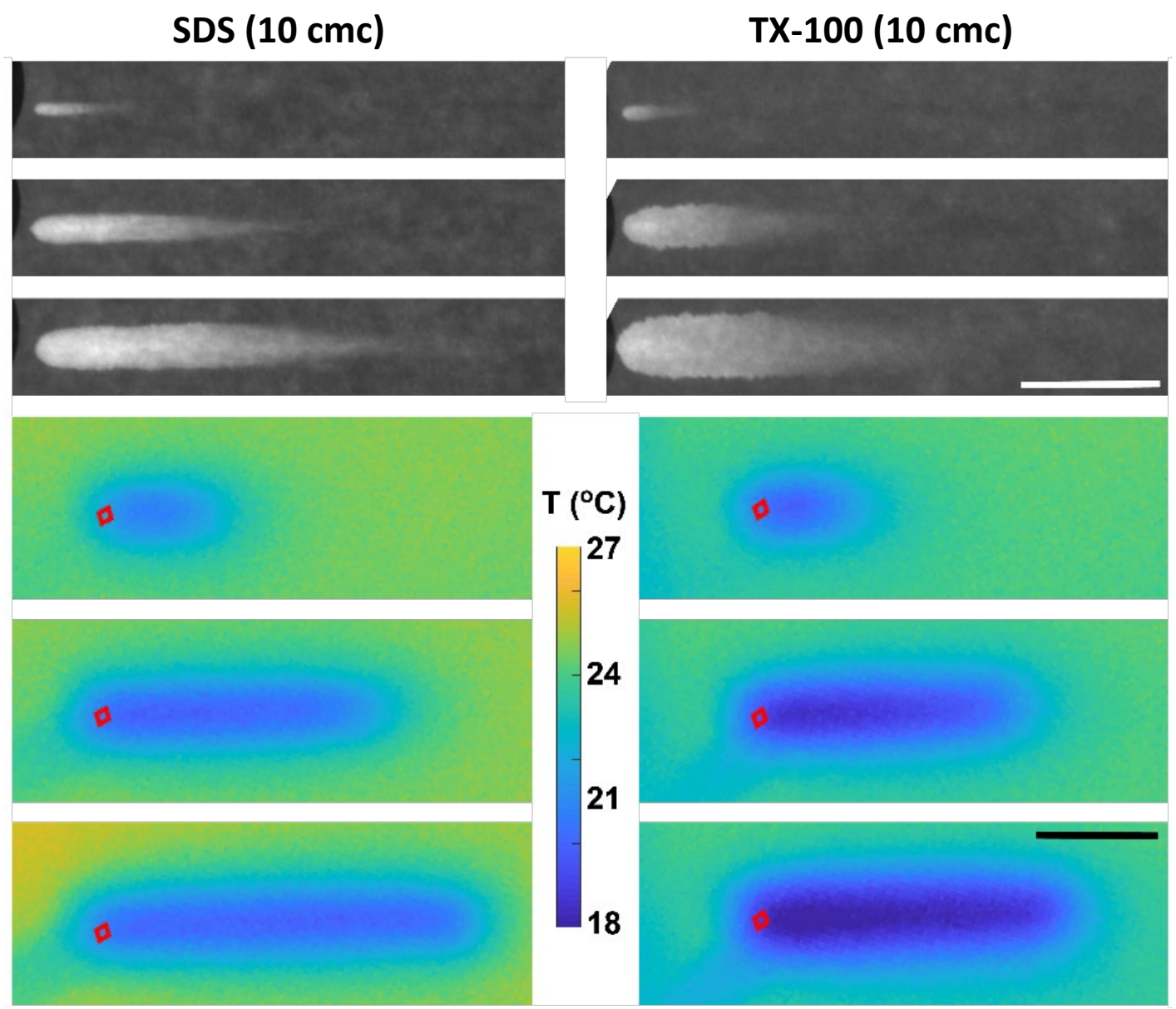
Inkjet deposition experiments

Variation of substrate speed



Inkjet deposition experiments

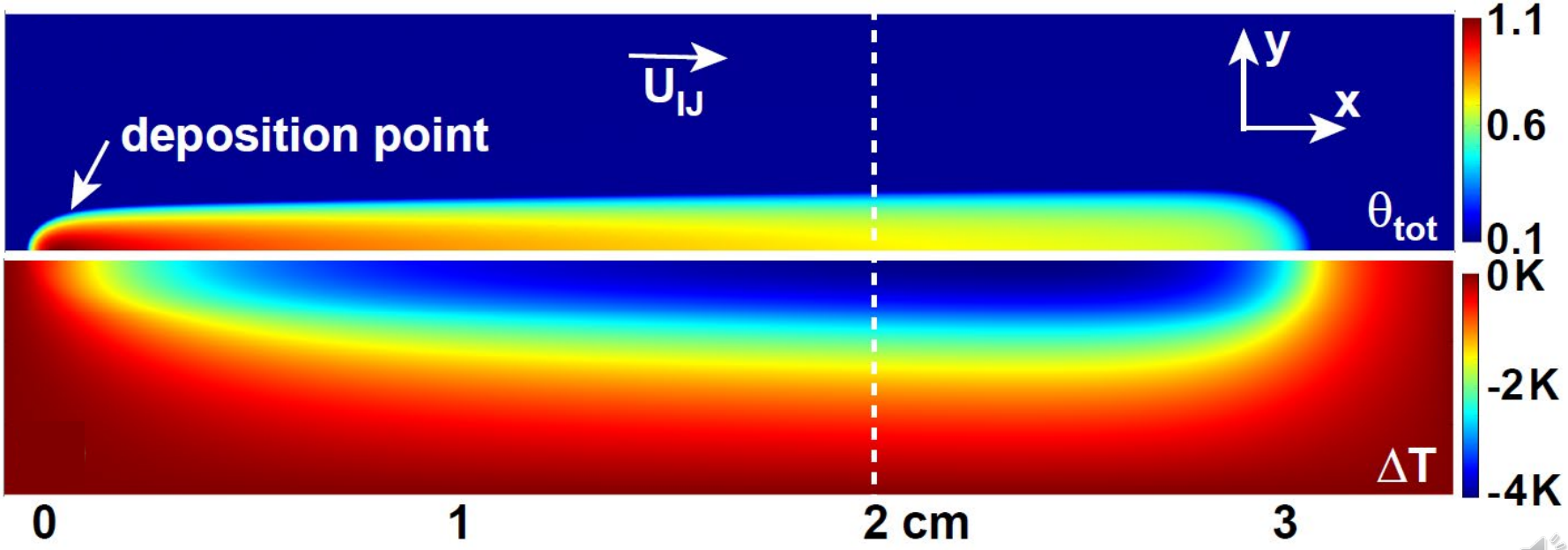
Variation of jetting frequency

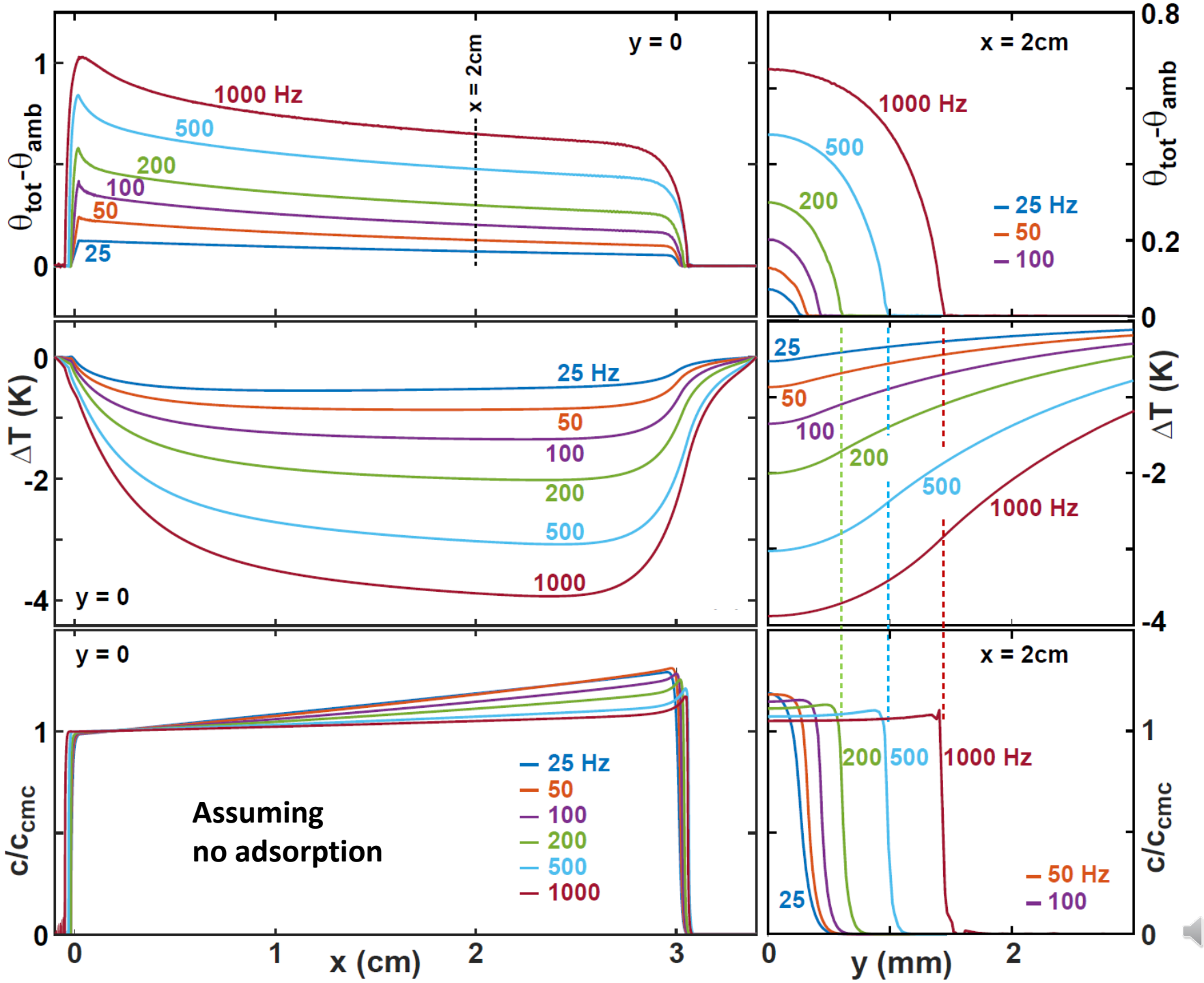


Numerical simulations

Model accounts for

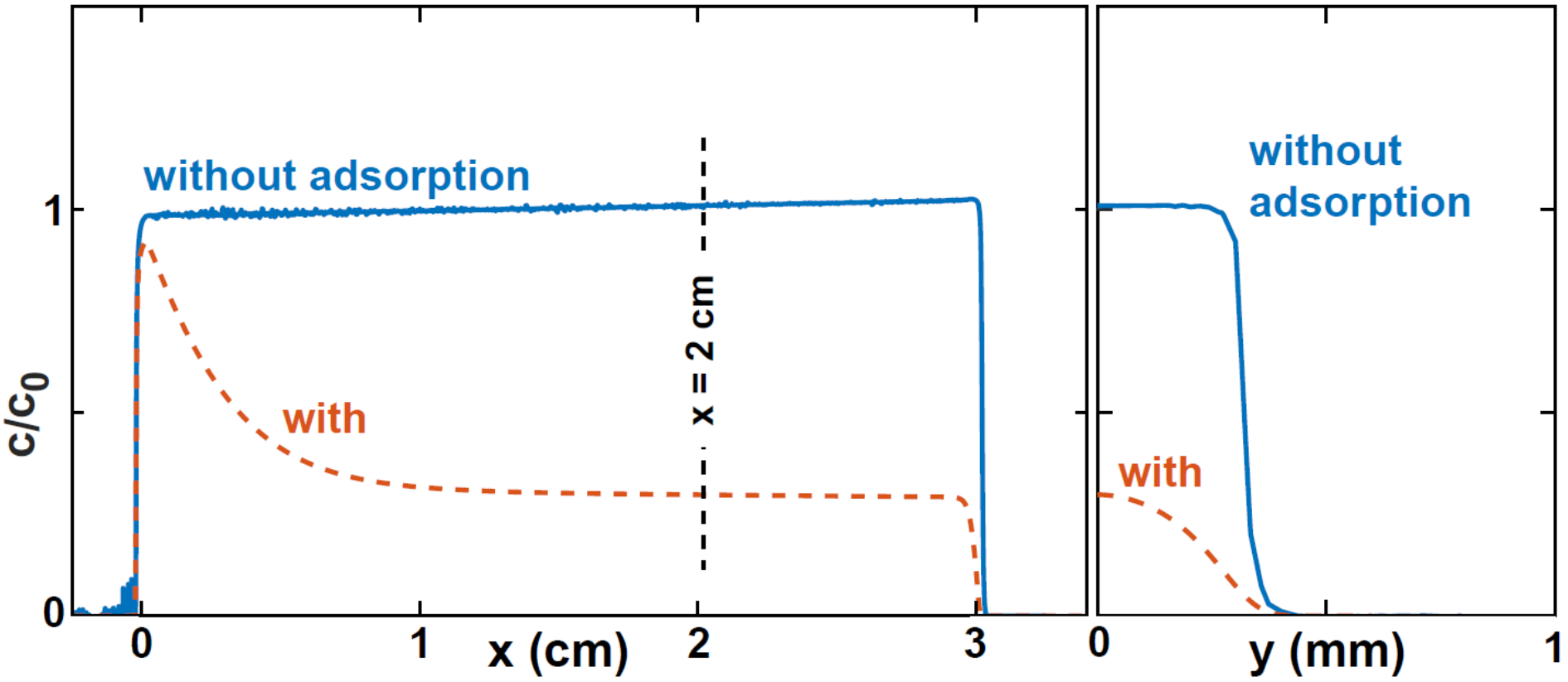
- Imbibition into pores & fibers (dual porosity approach)
- Water loss due to evaporation
- Heat transfer (evaporative cooling)
- Surfactant convection, dispersion and adsorption



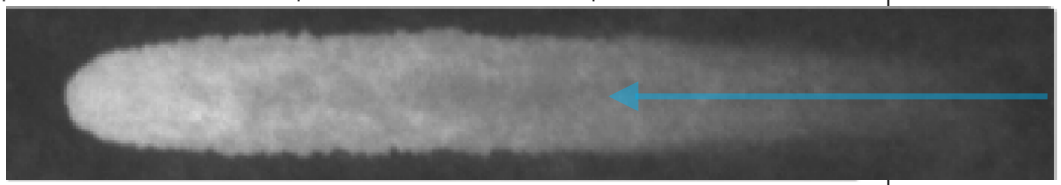

y = 0
x = 2cm
1000 Hz
500
200
100
50
25
θ_{tot}-θ_{amb}
x = 2cm
1000 Hz
500
200
– 25 Hz
– 50
– 100
θ_{tot}-θ_{amb}
0.8
0.2
0
25 Hz
50
100
200
500
1000
ΔT (K)
y = 0
25
50
100
200
500
1000 Hz
ΔT (K)
y = 0
x = 2cm
Assuming
no adsorption
– 25 Hz
– 50
– 100
– 200
– 500
– 1000
c/c_{cmc}
x (cm)
200 500 1000 Hz
25
– 50 Hz
– 100
c/c_{cmc}
y (mm)

Effect of surfactant adsorption

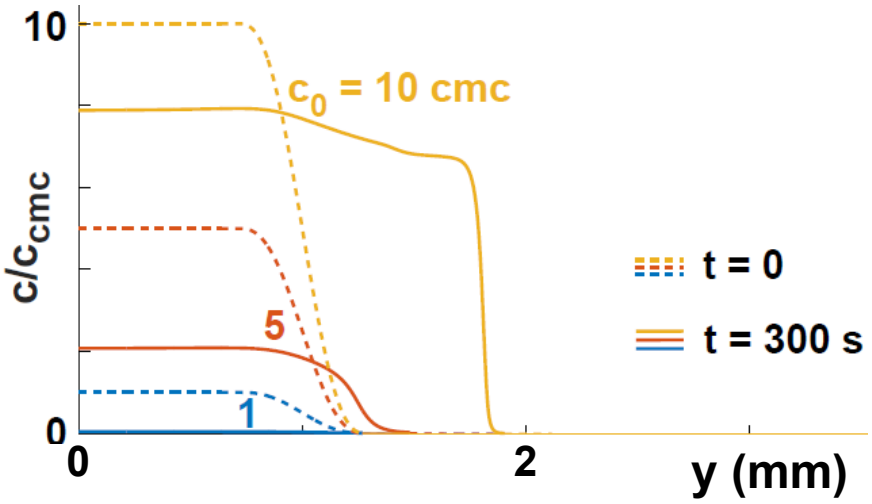
Langmuir isotherm

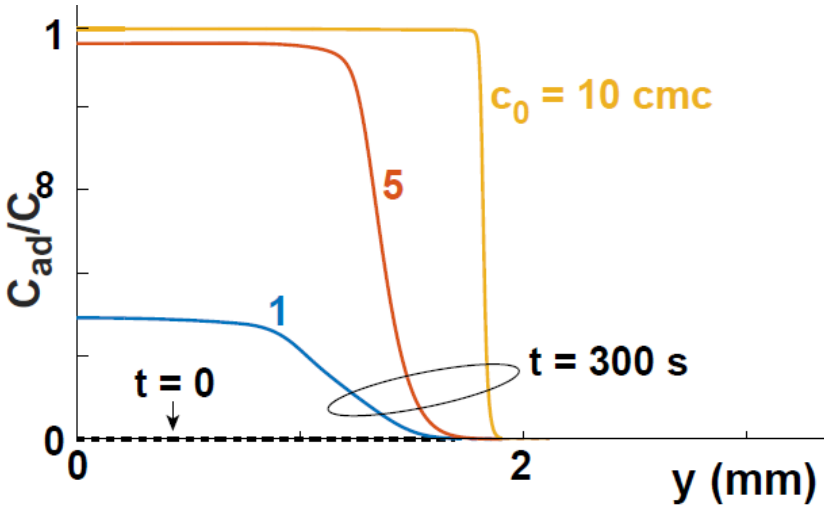


Effect of surfactant adsorption

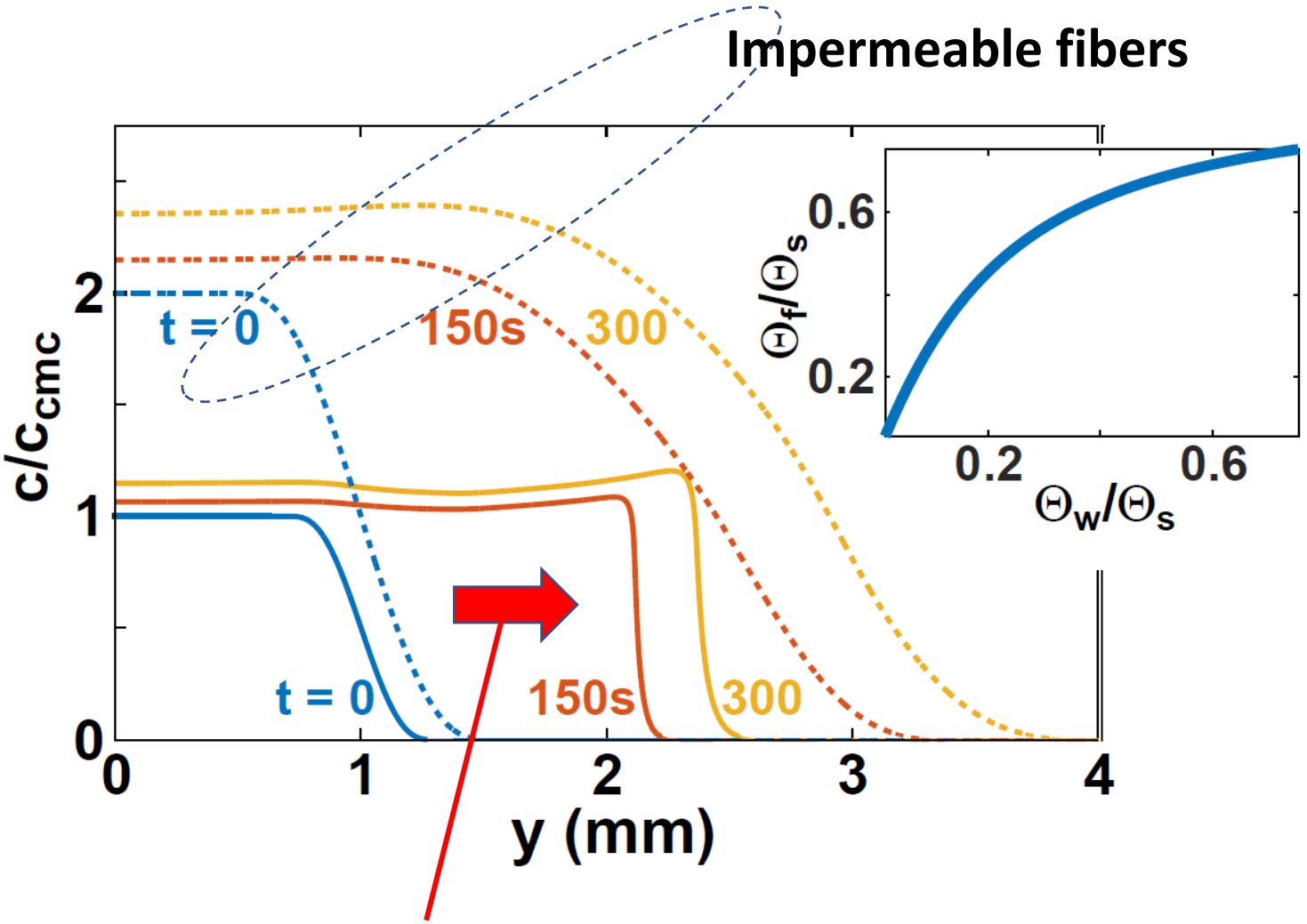


Dark zone





Effect of permeable fibers – dual porosity model



Self-steepening of bulk concentration distribution for permeable fibers

Assuming no adsorption

Summary and conclusions

Performed systematic experiments of inkjet deposition of lines of surfactant solutions onto moving paper substrates

Surfactants segregate from aqueous solvent for low concentrations

Dark zones observed in light transmission near deposition region

Developed comprehensive numerical model
Accounts for pores and permeable fibers

Model reproduces chromatographic retention and formation of dark regions with reduced moisture content

Model reproduces steepening of surfactant fronts at high concentrations