Modeling Porosity Development during Drying of Liquids and Slurries

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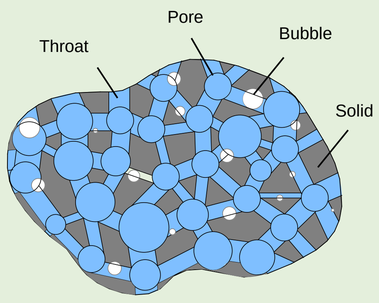
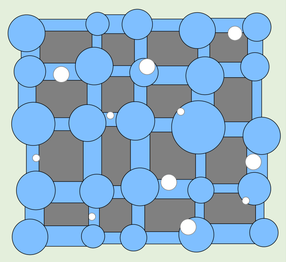
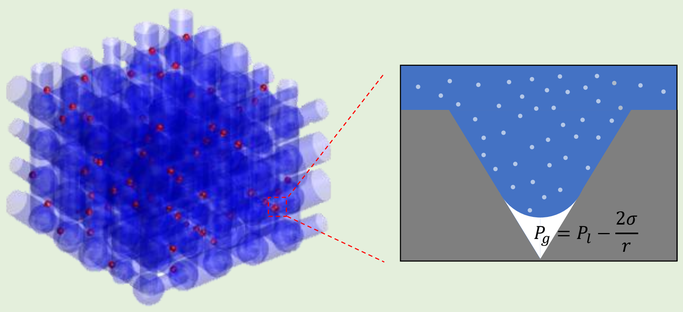
Previous Work: Modeling of Bubble Dynamics

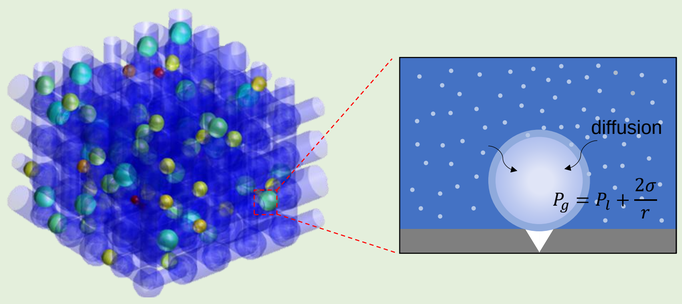




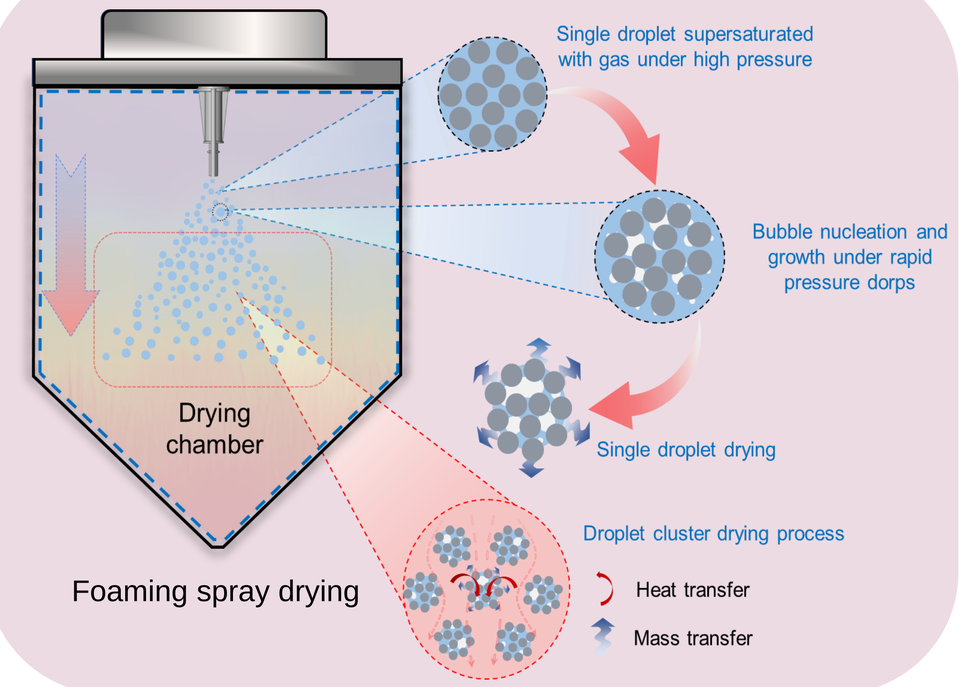
Single slurry droplet conceptualized as a pore-particle network



Geometry-controlled nucleation

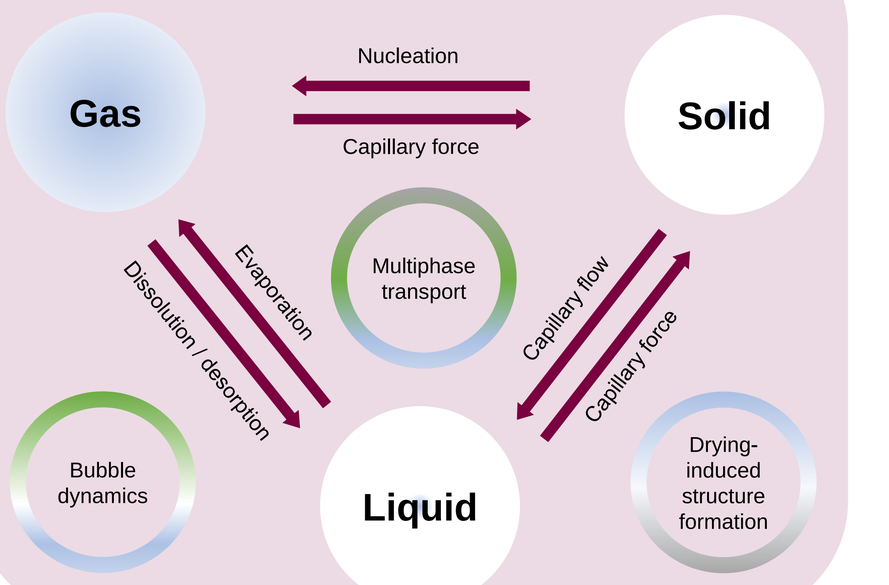


Gas diffusion-controlled bubble growth



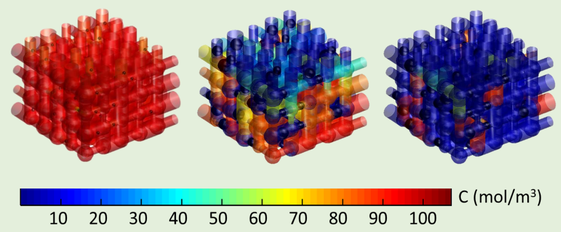
Foaming spray drying

Underlying Phenomena

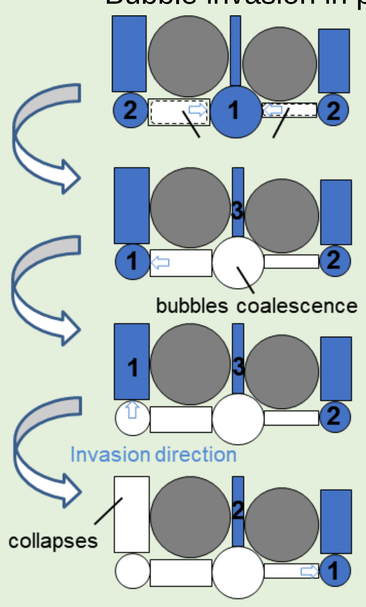


Present Work: Coupled Bubble Dynamics and Drying

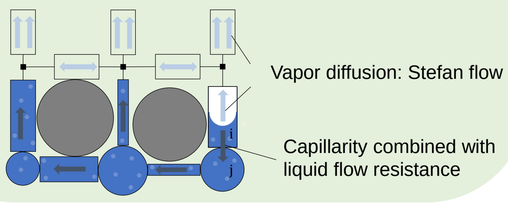
Gas diffusion in pore network



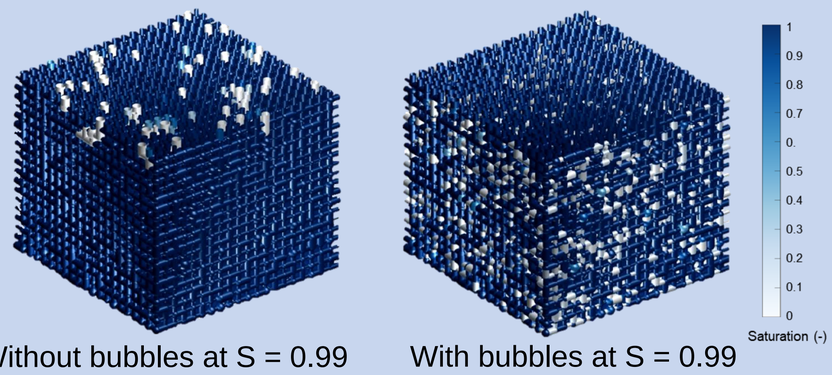
Bubble invasion in pore network



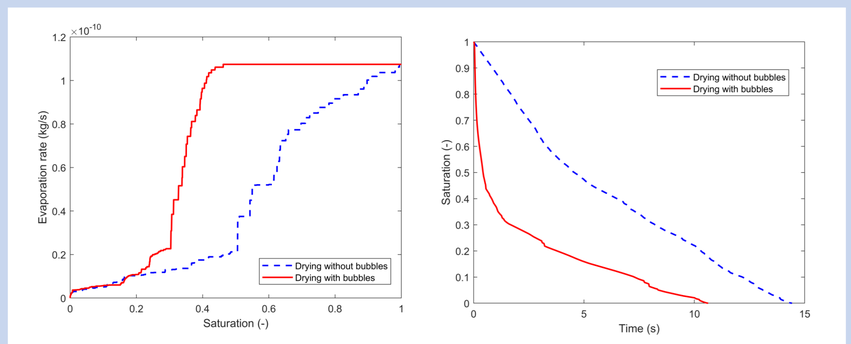
Drying of a pore network



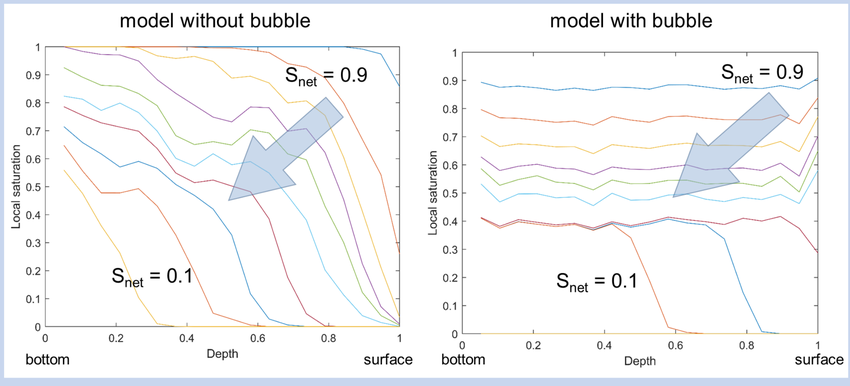
Drying kinetics and bubble dynamics



Without bubbles at S = 0.99 | With bubbles at S = 0.99

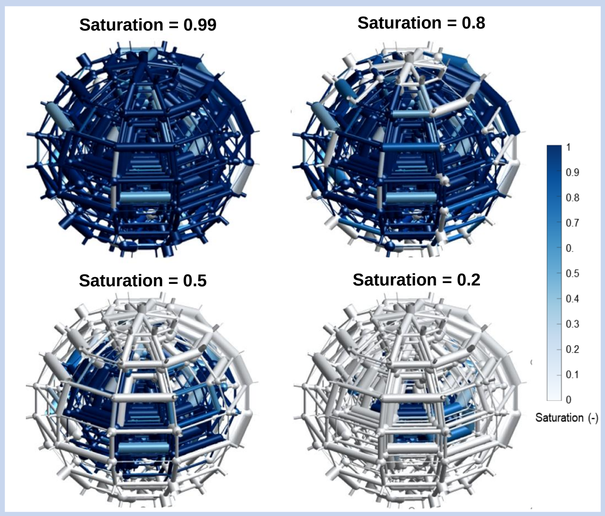


Drying kinetics: bubble vs. non-bubble PNM simulations

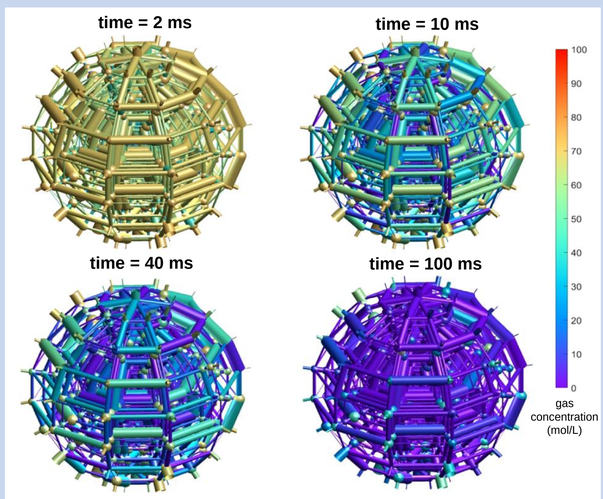


Saturation profiles: bubble vs. non-bubble PNM simulations

Same PNM, spherical network

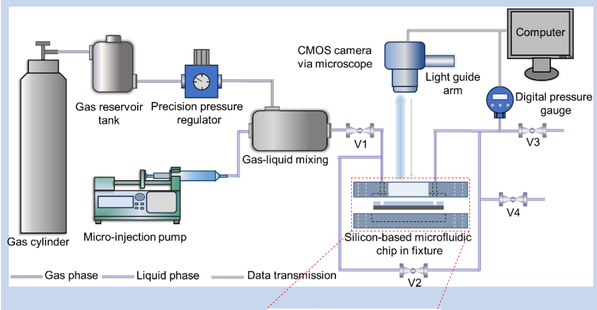


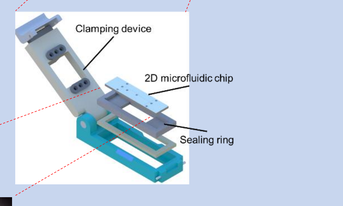
Evolution of saturation profiles

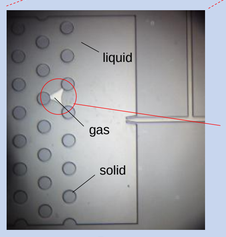


Evolution of gas concentration profiles

Microfluidic observation

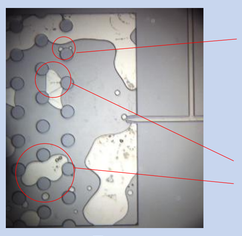






Concave interface formation at high pressure, 6 bar

0 s



Nucleation on particle surfaces

Convex interface resulting from pressure drop to 1 bar

5 s

Current status and future directions

Until now: Fixed structure, focus on drying kinetics with bubbles

Next: Model morphology evolution and its impact on drying kinetics

Acknowledgement

This work has received financial support from the International Fine Particle Research Institute (Project ID: 141A).