

Phase-field Simulation of Droplet Wetting and Impact Phenomena

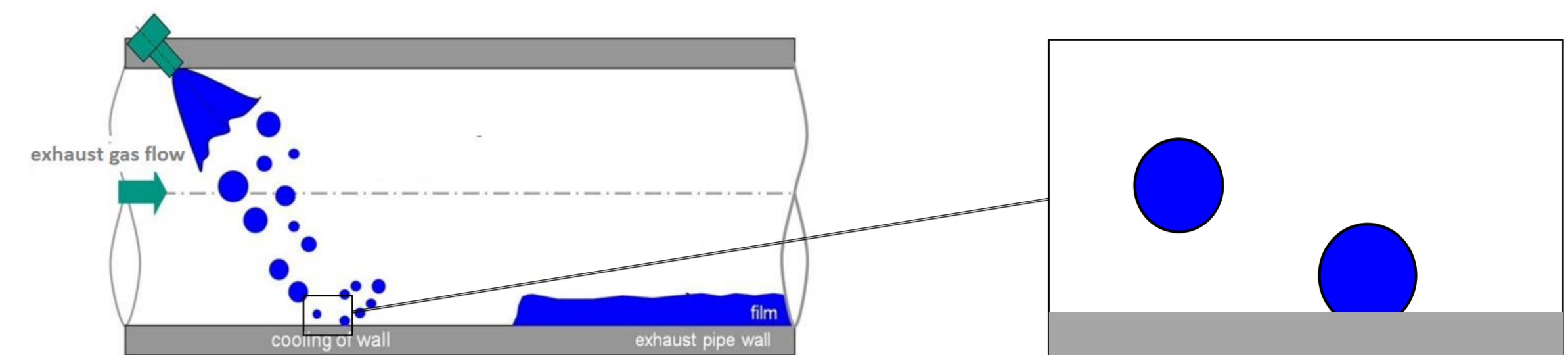
X. Cai¹, V. Fink², R. Bernard³, A. Stroh², Y. Wu¹, H. Marschall⁴, O. Deutschmann^{1,5}, B. Frohnafel², M. Wörner⁵

¹ Karlsruhe Institute of Technology
² Karlsruhe Institute of Technology
³ University of Stuttgart
⁴ Technische Universität Darmstadt
⁵ Karlsruhe Institute of Technology

Institute for Chemical Technology and Polymer Chemistry
Institute of Fluid Mechanics
Institute of Aerospace Thermodynamics
Mathematical Modeling and Analysis, Dep. of Mathematics
Institute of Catalysis Research and Technology

Motivation and goal

- Urea solution spray-wall-interaction in exhaust gas tailpipe
- Simulation of individual droplet wetting and impact on wall
- Simulation of liquid film formation on wall



Numerical method and code

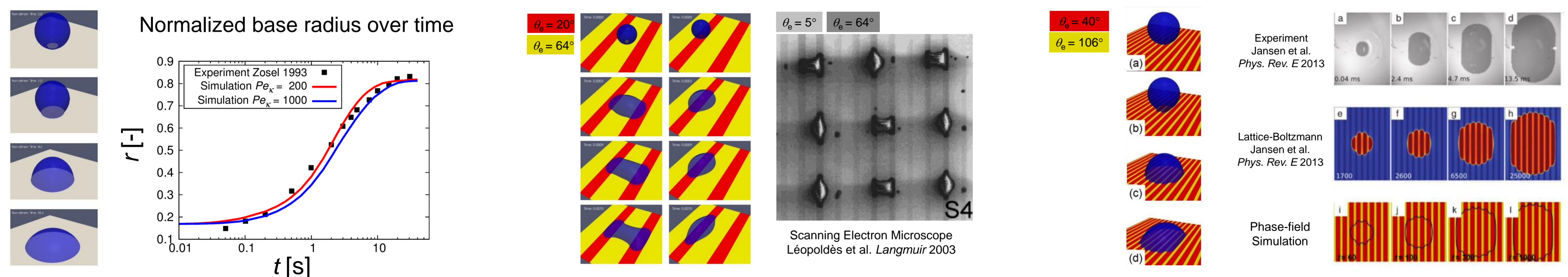
Phase-field method

- An interface-capturing method where interface is treated as being of certain thickness (also called "diffuse-interface method")
- Especially suited for moving contact line problem

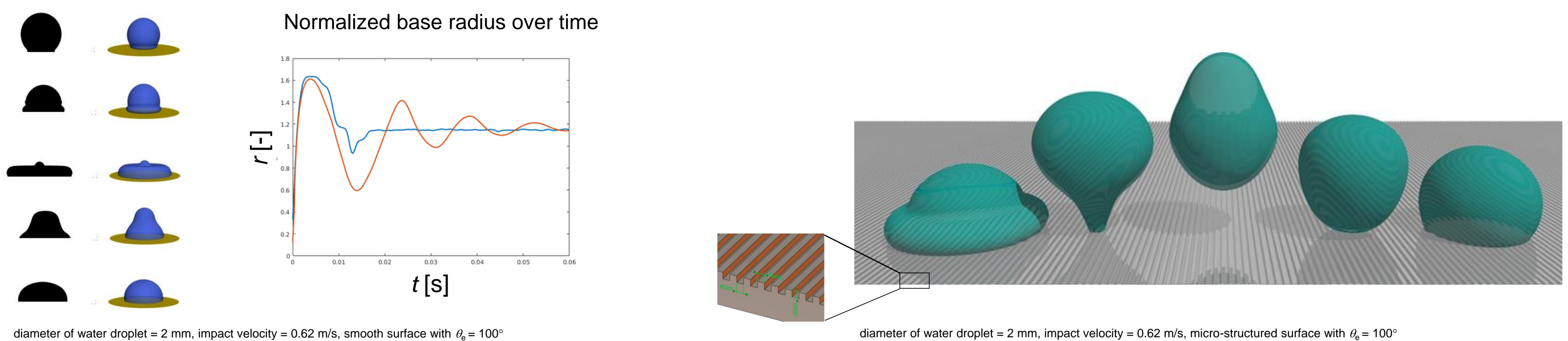
phaseFieldFoam

- A novel OpenFOAM solver implementing a Cahn-Hilliard based phase-field method coupled with Navier-Stokes equations
- Developed by the authors (Marschall and Cai)

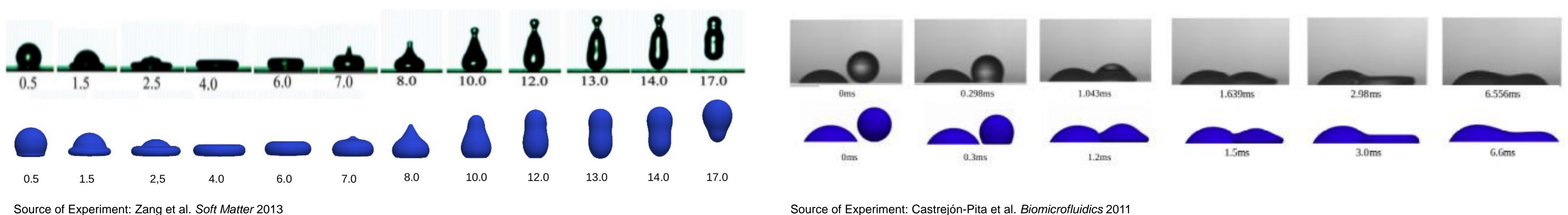
Droplet deposition on homogeneous and chemically-patterned surface



Droplet impact on smooth and micro-structured surface

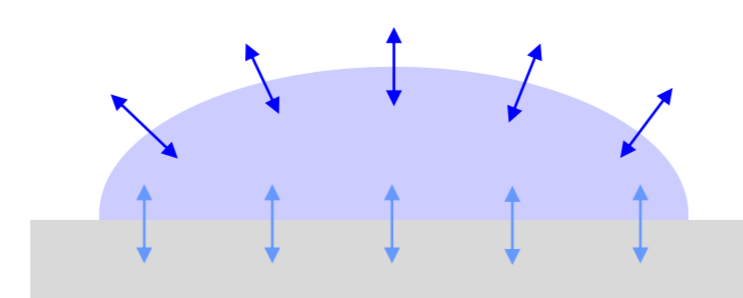


Work-in-progress: rebound and coalescence



Further steps

- Evaporation of droplet
- Heat Transfer btw. droplet and wall



Acknowledgement



References

- Cai, Marschall, Wörner and Deutschmann, *Chem. Eng. Technol.* 2015, 38: 1985–1992.
Cai, Dissertation, 2016, Karlsruher Institut für Technologie

- Cai, Wörner, Marschall and Deutschmann, *Catalysis Today* 2016, 273: 151–160.
Fink, Bernard, Marschall, Wörner, Frohnafel and Cai, *Jahrestreffen der ProcessNet Fachgruppe CFD* 2017, Dresden

