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液滴动力学与蒸发动力学学术研讨会

2025 年 3 月 9 日

数学科学学院西楼　华南数学应用与交叉研究中心 111 报告厅

时　　间	报告人	报告题目	主持人
8:40—8:50	丁时进	致开幕词	李进开
8:50—9:20	付　东	印刷显示技术发展概况	李进开
9:20—9:30		印刷显示技术发展概况　(讨论)	
9:30—10:00	钱铁铮	Modelling and Numerical Simulation for Evaporating Droplets	王筱平
10:00—10:10		Modelling and Numerical Simulation for Evaporating Droplets　(讨论)	
10:10—10:30	茶　　歇		
10:30—11:00	高　敏	Simulation Method of Microscale Fluid-Structure Interactions: Diffuse-Resistance-Domain Approach	董　婷
11:00—11:10		Simulation Method of Microscale Fluid-Structure Interactions: Diffuse-Resistance-Domain Approach (讨论)	
11:10—11:40	张金鹏	An efficient unconditional energy stable scheme for the simulation of droplet formation and spreading on solid surfaces	王　东
11:40—11:50		An efficient unconditional energy stable scheme for the simulation of droplet formation and spreading on solid surfaces (讨论)	
11:50—12:00	姚正安	致闭幕词	丁时进
12:00—14:30	合影、午餐		
14:30—17:30	自 由 讨 论		

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报告题目及摘要

印刷显示技术发展概况

付东
(广东聚华印刷显示技术有限公司)

主要介绍印刷显示的概念，以及其在显示领域的定位；并对印刷 OLED 技术与其他几类 OLED 技术路线的竞争优势展开了分析，同时对印刷显示的未来发展方向进行了展望；印刷显示产业应用方面，报告从材料、工艺、装备、集成应用等维度探讨了印刷显示产业化发展的道路，最后提出了当前产业的新需求与挑战方向。

Modelling and Numerical Simulation for Evaporating Droplets

钱铁铮
(香港科技大学数学系)

Sessile liquid droplets on solid surfaces are ubiquitously found in nature and practical applications. They exhibit many intriguing properties and phenomena because their dynamics involve three phases interacting with each other, i.e., liquid, gas, and solid. Many physical processes participate in droplet dynamics, making it an intriguing problem for fundamental understanding and practical applications.

Out of the many physical processes involved in droplet dynamics, two are of particular and continuous interest to the research community because of the roles they play and the difficulties they present. The first is the contact line at which the liquid-gas interface intersects the solid surface. As the three phases meet at the contact line, its motion involves the microscopic dynamics in the three-phase region coupled to the macroscopic hydrodynamics of the droplet. The second is the evaporation taking place at the liquid-gas interface for sessile evaporating droplets. Coupled to both the moving contact line on the solid surface and the advective flow in the liquid, the continuous liquid evaporation plays a critical role in the control of droplet dynamics.

Based on our earlier works on the modelling of contact line dynamics and thin film dynamics, we derive a continuum model for evaporating droplets by applying Onsager's variational principle. This approach ensures thermodynamical consistency in describing the coupling of many physical processes, including viscous momentum transport in the liquid, diffusive transport in the liquid (for binary mixture), contact line motion, evaporation, and vapor diffusion.

We will present a numerical scheme that is designed to couple the liquid thin film equation with the vapor diffusion equation, together with some preliminary numerical results.

This work is supported by the Hong Kong RGC General Research Fund (grant No. 16306121) and the Key Project of the National Natural Science Foundation of China (No. 12131010).

Simulation Method of Microscale Fluid-Structure Interactions: Diffuse-Resistance-Domain Approach

高敏
(广州工商学院)

Direct numerical simulations (DNS) of microscale fluid-structure interactions (mFSI) in multicomponent multiphase flows pose many challenges such as the thermodynamic consistency of multiphysics couplings, the tracking of moving interfaces, and the dynamics of moving triple-phase contact lines. We propose and validate a generic DNS approach: Diffuse-Resistance-Domain (DRD). It overcomes the above challenges by employing Onsager's principle to formulate dynamic model and combining traditional diffuse-interface models for fluid-fluid interfacial dynamics with a novel implementation of complex fluid-solid interfacial conditions via smooth interpolations of dynamicresistance coefficients across interfaces. After careful validation by benchmark simulations, we simulated three challenging mFSI problems taken from different fields. This generic DNS approach offers a promising tool for understanding physical mechanisms, controlling microscale fluids, and optimizing engineering processes in microfluidics, additive manufacturing, and biomedical engineering.

An efficient unconditional energy stable scheme for the simulation of droplet formation and spreading on solid surfaces

张金鹏
(澳门大学)

We develop an efficient and unconditionally energy-stable method for simulating droplet formation and spreading on solid surfaces. Our approach involves a novel time-marching scheme based on the scalar auxiliary variable technique, specifically designed for solving the Cahn-Hilliard-Navier-Stokes phase field model with variable density and viscosity. To tackle the challenges posed by complex boundary conditions, we introduce additional nonlocal auxiliary variables and associated ordinary differential equations. These additions effectively eliminate the influence of boundary terms. Moreover, we incorporate stabilization terms into the scheme to enhance its

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numerical effectiveness. Notably, our resulting scheme is fully decoupled, requiring the solution of only linear systems at each time step. We also demonstrate the energy decaying property of the scheme, with suitable modifications. To assess the accuracy and stability of our algorithm, we conduct extensive numerical simulations. Overall, our work presents a refined method for simulating droplet formation and spreading on solid surfaces, offering improved efficiency, energy stability, and accuracy.