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PREFACE

Dynamics of wetting

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Capillary phenomena associated with fluids wetting other condensed matter phases have drawn great scientific interest for hundreds of years; consider the recent bicentennial celebration of Thomas Young's paper on equilibrium contact angles, describing the geometric shape assumed near a three phase contact line in terms of the relevant surface energies of the constituent phases [1]. Indeed, nearly a century has passed since the seminal papers of Lucas and Washburn, describing dynamics of capillary imbibition [2, 3]. While it is generally appreciated that dynamics of fluid wetting processes are determined by the degree to which a system is out of capillary equilibrium, myriad complications exist that challenge the fundamental understanding of dynamic capillary phenomena. The topic has gathered much interest from recent Nobel laureate Pierre-Gilles de Gennes, who provided a seminal review of relevant dissipation mechanisms for fluid droplets spreading on solid surfaces [4]. Although much about the dynamics of wetting has been revealed, much remains to be learned and intrinsic technological and fundamental interest in the topic drives continuing high levels of research activity. This is enabled partly by improved experimental capabilities for resolving wetting processes at increasingly finer temporal, spatial, and chemical resolution. Additionally, dynamic wetting research advances via higher fidelity computational modeling capabilities, which drive more highly refined theory development.

The significance of this topic both fundamentally and technologically has resulted in a number of reviews of research activity in wetting dynamics. One recent example addresses the evaluation of existing wetting dynamics theories from an experimentalist's perspective [5]. A *Current Opinion* issue was recently dedicated to high temperature capillarity, including dynamics of high temperature spreading [6]. New educational tools have recently emerged for providing instruction in wetting dynamics and the broader field of fluid dynamics [7–9]. Such an active field requires an occasional collective examination of current research to highlight both recent successes and remaining challenges.

Herein, we have collected a range of articles to illustrate the broad nature of research associated with understanding dynamics of moving condensed matter three phase contact lines. Despite the breadth of topics examined, certain unifying themes emerge. The role of the substrate surface is critical in determining kinetics of wetting; this is evidenced by the attention given to this in articles herein. McHale *et al* investigate the role of surface topography on wetting kinetics and how its effect can be incorporated in existing theories describing contact line dynamics. Moosavi *et al* examine surface topography effects via a mesoscopic hydrodynamics approach. The capillary driven motion of fluid through structures on a surface bears tremendous importance for microfluidics studies and the emerging field of nanofluidics. Blow *et al* examine this phenomena for liquid imbibition into a geometric array of structures on a solid surface, while Shen *et al* analyze the effects of surface temperature during boiling and non-boiling conditions on droplet impingement dynamics. Finally, Pesika *et al* discover a wonderful world of smart surfaces, like gecko adhesion pads.

A number of papers utilize computational modeling to explore phenomena underlying wetting dynamics and to consider relevant mechanisms in terms of existing theory for contact line dynamics. Winter *et al* utilize Monte Carlo simulation techniques and thermodynamic integration methods to test classical theory describing heterogeneous nucleation at a wall near a wetting transition.

Qian *et al* briefly review the Onsager principle of minimum energy dissipation underlying many descriptions of dissipative systems; they then provide a variational approach description of hydrodynamics of moving contact lines and demonstrate the validity of their continuum model via comparison with molecular dynamics simulations. Bertrand *et al* use large scale molecular dynamics simulations to examine fundamental questions about wetting dynamics and how they depend upon interactions between a liquid drop and solid substrate; in particular, atomic scale mechanisms directly associated with the molecular kinetic theory of wetting are observed and quantified. Sun *et al* explore, by molecular dynamics simulations, atomistic mechanisms of high temperature contact line advancement for a rapidly spreading liquid droplet.

Starov *et al* discuss general aspects of surface forces and wetting phenomena, while Courbin *et al* present an overview of diverse dynamical processes ranging from inertial spreading to viscous imbibition. Mukhopadhyay *et al* examine the effect of Marangoni and centrifugal forces on the wetting dynamics of thin liquid films and drops. Willis *et al* analyze an enhanced droplet spreading due to thermal fluctuations.

How wetting and contact line dynamics depend upon the complexity of the structure in the liquid is interesting both academically and technologically; Delabre *et al* illustrate this with a study of wetting of liquid crystals and the role of molecular scale organization. In addition, Mechkov *et al* explore this realm by studying post-Tanner spreading for nematic droplets and, in general, post-Tanner spreading of liquid droplets governed by the contact line-tension effects. Liang *et al* focus on spreading dynamics of power-law fluid droplets, while Wei *et al* discuss dynamics of wetting in viscous Newtonian and non-Newtonian fluids. Yin *et al* discuss an important issue of reactive wetting in metal–metal systems.

We hope that the articles gathered here will permit readers to understand the wide range of condensed matter systems impacted by wetting kinetics and the many complicating factors that emerge in describing contact line dynamics for realistic materials. We wish to thank all the contributing authors for their effort and support of our endeavour.

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