IMA11—interfacial fluid dynamics

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Abstract This special issue presents recent advances on interfacial fluid dynamics, in link with the 11th conference of the International Marangoni Association organized in Bordeaux, France, on June 2023.

The International Marangoni Association (IMA) conferences are devoted to problems related to interfacial fluid mechanics and transport phenomena. Although the Marangoni effect represents the major aspect of the conference, all interfacial-related transport is covered. The 11th edition of this conference series was organized in Bordeaux, France, on June 19–22, 2023. The IMA11 conference was chaired by S. Amiroudine (I2M, University of Bordeaux) and co-chaired by T. Bickel (LOMA, University of Bordeaux).

Topics are of fundamental aspect and include bubbles/drops flows, hydrodynamic instabilities, hydraulic jump, wave breaking, electrokinetic instabilities, contact line dynamics, evaporation process, solute transport, Maxwell fluid, Marangoni wave pattern with surfactants and some other processes.

These fundamental studies find industrial applications in the fields of foams, materials processing, desalination processes, oil recovery, environmental problems, separation technology, space processing, corrosion erosion and biomedical transport in the human airways or contact lenses, to name only a few examples.

This special issue "IMA11: Interfacial fluid dynamics" gathers recent works from this very active field of research. A brief overview of the different topics covered in this special issue are given below.

– In the last few years, there has been much interest in nanofluids on a global scale because of their thermal implications in engineering and biological sciences. There is a possibility of suspending organized nanoparticles in one base fluid to further boost the thermal performance of conventional ordinary fluids, even though the performance of nanofluids is well known and has shown promising results in heat transport phenomena [1].
– Single traveling waves (STW) generated by the oscillatory instability of Marangoni convection in the thin non-isothermal liquid layer with deformable free surface is considered. The layer is covered by insoluble surfactant that plays an active role in the pattern selection, together with inhomogeneity of temperature along the interface and surface deformability [2].
– When a pure water drop evaporates on a salty substrate, it experiences the simultaneous dissolution of the solid, evaporation of the liquid, advection of the dissolved species, and nucleation and growth of a salt deposit in the constrained geometry of the pinned drop [3].
– The preconcentration of a negatively charged analyte (protein, DNA, biomolecule, etc.) in a buffer solution of electrolyte near a cation-exchange membrane is very important in biomedical applications [4].
– The flow of a homogeneous and stratified fluid in a channel with topography is considered. The narrow-gap approximation is adopted as the theoretical approach to study the limit situation and compared with OpenFOAM simulations [5].
– The spread of a jet impacting on a circular disk and the hydraulic jump of a viscoelastic fluid of the Oldroyd-B type are considered. The depth-averaging approach is employed in the supercritical region. The subcritical flow is assumed to be inertialess of the lubrication type, and the downstream boundary condition is assumed to be a

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known parameter. The jump is treated as an abrupt shock, where the balance of mass and momentum is applied across it in the radial direction [6].
- A mesoscopic hydrodynamic model for drops of binary mixtures of volatile partially wetting liquids on brush-covered substrates is introduced. The formulation as gradient dynamics on an underlying free energy functional allows to systematically account for cross couplings between the six scalar fields needed to describe the two components within the three phases—brush, drop and gas [7].
- The onset of non-spherical oscillations of a microbubble in an unbounded power-law liquid is studied. Two kinds of instabilities, namely parametric and Rayleigh–Taylor instabilities, are investigated. Unlike Newtonian liquids, the viscosity of power-law liquids is affected by the frequency of the acoustic field, thereby affecting the Rayleigh–Taylor instability [8].
- When a liquid is spin coated onto a curved surface, the flow is driven by complex rotational dynamics. Centrifugal forces dominate above a critical angular velocity, pushing the fluid away from the instantaneous axis of rotation. This enables the formation of the curved polymer coating with improved thickness control [9].
- The flow field in the vicinity of a moving contact line is studied by particle image velocimetry for a liquid–liquid interface, allowing for direct comparison with theoretical models. Experiments reveal a slowing down as the contact line is approached, as well as the presence of slip along the moving wall [10].
- Surface waves at the interface of a shallow liquid layer confined in an annular channel are generated by periodic acceleration along the azimuthal direction. If the oscillations are anharmonic, a mean mass flow is generated even if the mean speed is zero. Experimental measurements are confirmed by numerical simulations including inertia and dissipation [11].
- In time-dependent traveling wave convection, small particles are known to form three-dimensional structures. Experiments are carried out in high aspect ratio thermocapillary liquid bridges. Coherent structures with different azimuthal wave numbers then emerge from oscillatory convection due to hydrothermal wave instabilities [12].
- Spilling and plunging breaking waves are studied numerically. At moderate steepness, spilling breaking occurs in qualitative agreement with experiments. At larger steepness, a dramatic plunging breaking is observed. The number and size distribution of bubbles are measured with good agreement with previous experimental data [13].
- The effect of ultrasound on the behavior of an air bubble in a liquid near a solid plate is investigated experimentally. It is shown that ultrasounds can be used to tune the wettability of the solid surface. These results are relevant regarding for instance the flotation of mineral raw materials [14].

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