

## MULTIPHASE FLOWS IN PLASMA-DRIVEN SYSTEMS

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### ABSTRACT

Plasma–fluid interactions involving multiphase systems are central to a wide range of industrial and scientific applications, including arc welding, plasma spraying, plasma–liquid processing, and high-temperature material synthesis. In these systems, complex coupling arises between ionized gases, neutral species, and condensed phases such as liquid droplets or solid surfaces, leading to rich interfacial phenomena governed by nonlinear interactions among electromagnetic forces, phase change, and fluid dynamics.

Despite significant advances in both plasma modeling and multiphase flow simulation, the integration of these two domains remains limited. Conventional plasma models often rely on continuum descriptions that neglect interfacial dynamics, while multiphase flow models typically ignore plasma-specific effects such as electromagnetic force, charge transport, and ion–neutral interactions. This disconnect hinders accurate prediction of key processes such as droplet detachment and transport in arc plasmas, interfacial instabilities under electric fields, and reactive transport in plasma–liquid systems.

This Minisymposium aims to bring together researchers working at the intersection of plasma physics and multiphase flow to address these challenges. The focus will be on both fundamental and applied aspects, including: (i) interfacial dynamics under plasma exposure, (ii) numerical methods for coupled plasma–multiphase systems, such as lattice Boltzmann, phase-field, and particle-based approaches, (iii) transport phenomena involving charged and neutral species across phase boundaries, and (iv) multiscale modeling strategies bridging kinetic, mesoscopic, and continuum descriptions.

Particular attention will be given to emerging modeling frameworks that enable consistent treatment of interface physics and plasma transport processes, as well as to validation against experimental observations. Contributions addressing high-temperature plasmas, strong nonequilibrium effects, and complex geometries are especially encouraged.

By fostering cross-disciplinary dialogue, this Minisymposium seeks to clarify current limitations, identify critical knowledge gaps, and promote the development of predictive models for plasma-driven multiphase systems. The outcomes are expected to advance both the theoretical understanding and practical design of plasma-assisted technologies.