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Tentative topic of the invited talk

Corona-induced crowning of water droplet under strong electric field gradient—a curious case of missing Taylor cone.

Abstract of the invited talk

Electrohydrodynamics (EHD) is a fascinating and intricate area of physics, particularly notable for how it describes the behavior of liquid droplets when exposed to an electric field. Taylor's groundbreaking findings on the breakup of droplets under electric fields forged a crucial link between electrostatics and hydrodynamics. Lord Rayleigh was the first to lay down the theoretical groundwork for understanding the instabilities at liquid interfaces due to static charges, positing the crucial limit on the amount of charge a freely floating droplet can hold. Building on Rayleigh's concepts, Taylor expanded this idea to explain the breakup of droplets resting on surfaces when subjected to a uniform electric field. He illustrated how these droplets morph from a spherical cap into a cone shape, now known as the Taylor cone, from which fine droplets are projected towards an oppositely charged electrode. This process has become a key feature in today's electrohydrodynamic jet printing technology. In our exploration of how high voltage influences the shapes of sessile and pendant droplets, we conducted experiments aimed at pinpointing the conditions that lead to the formation of Taylor cones on various surfaces with differing wettability. During our investigations, we encountered an unexpected phenomenon: the Taylor cone, at the very moment of its formation, would vanish, giving way to what we are describing as "crowning." To our knowledge, this occurrence has not been reported previously. Notably, this crowning effect was observed only with sessile, de-ionized water droplets on superhydrophobic surfaces showing a Cassie-Baxter wetting behavior. In contrast, pendant droplets exhibited crowning with de-ionized water regardless of the substrate's wettability. We aim to unravel this intriguing phenomenon through a more thorough study, delving into the interactions among ion transfer, electric fields, and droplet dynamics, ultimately enhancing our understanding of this remarkable behavior.