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Electric field effects on droplet burning ADVITYA PATYAL, University of Illinois at Urbana-Champaign, DIMITRIOS KYRITSIS, Khalifa University, MOSHE MATALON, University of Illinois at Urbana-Champaign — The effects of an externally applied electric field are studied on the burning characteristics of a spherically symmetric fuel drop including the structure, mass burning rate and extinction characteristics of the diffusion flame. A reduced three-step chemical kinetic mechanism that reflects the chemi-ionization process for general hydrocarbon fuels has been proposed to capture the production and destruction of ions inside the flame zone. Due to the imposed symmetry, the effect of the ionic wind is simply to modify the pressure field. Our study thus focuses exclusively on the effects of Ohmic heating and kinetic effects on the burning process. Two distinguished limits of weak and strong field are identified, highlighting the relative strength of the internal charge barrier compared to the externally applied field, and numerically simulated. For both limits, significantly different charged species distributions are observed. An increase in the mass burning rate is noticed with increasing field in either limit with negligible change in the flame temperature. Increasing external voltages pushes the flame away from the droplet and causes a strengthening of the flame with a reduction in the extinction Damkhöler number.

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