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Scaling laws for first and second generation electrospray droplets OSMAN BASARAN, KRISHNARAJ SAMBATH, CHRISTOPHER ANTHONY, ROBERT COLLINS, BRAYDEN WAGONER, MICHAEL HARRIS, Purdue University — When uncharged liquid interfaces of pendant and free drops (hereafter referred to as parent drops) or liquid films are subject to a sufficiently strong electric field, they can emit thin fluid jets from conical tip structures that form at their surfaces. The disintegration of such jets into a spray consisting of charged droplets (hereafter referred to as daughter droplets) is common to electrospray ionization mass spectrometry, printing and coating processes, and raindrops in thunderclouds. We use simulation to determine the sizes and charges of these first-generation daughter droplets which are shown to be Coulombically stable and charged below the Rayleigh limit of stability. Once these daughter droplets shrink in size due to evaporation, they in turn reach their respective Rayleigh limits and explode by emitting yet even smaller second-generation daughter droplets from their conical tips. Once again, we use simulation and theory to deduce scaling laws for the sizes and charges of these second-generation droplets. A comparison is also provided for scaling laws pertaining to different generations of daughter droplets.

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