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Water-in-oil emulsification in a non-uniform alternating electric field SUHWAN CHOI, ALEXEI SAVELIEV, North Carolina State University — The emulsification of a water microdroplet placed in castor oil was performed using a non-uniform alternating electric field formed in the pin-to-plate geometry. A non-uniform electric field of ∼40 kV/mm alternating with a frequency of 6.7 kHz was generated near the pin electrode. The applied frequency exceeded charge relaxation frequency of castor oil (0.3 Hz) and was below charge relaxation frequency of deionized water (7.8 kHz) used in the experiments. The emulsification process was captured with a CCD camera. The emulsification process started with entrainment of the water droplet in the high electric filed region near the pin electrode under the dielectrophoretic force. Upon touching the pin, the microdroplet was disintegrated in numerous channels and secondary droplets. The process continued by entrainment of secondary droplets and continuous size reduction. Three droplet breakup mechanisms were identified: drop elongation and capillary breakup, ac electrospraying of individual droplets, chain and bridge formation and decay. The quasi-steady narrow size distribution of emulsified water droplets with diameters close to 1 μm was formed after a few minutes. The generated emulsion was confined near the needle electrode due to the dielectrophoretic force. The emulsion had a well-defined boundary with a shape resembling a pendant drop suspended on the pin electrode.

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