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Squeezing to Bending Transitions of Interfacial Electrohydrodynamic Instabilities for Digitization and Mixing of Two-Phase Microflows[1] JOYDIP CHAUDHURI[2], TAPAS KUMAR MANDAL[3], DIPANKAR BANDYOPADHYAY[4], IIT Guwahati — External field induced interfacial instabilities have shown significant potential in the miniaturization of flow patterns inside the microfluidic devices. Electric field induced instabilities in a trilayer oil-water microflow is explored with the help of analytical models and computational fluid dynamics simulations. Twin oil-water interfaces undergo either in-phase bending or anti-phase squeezing mode of deformation when a direct current (DC) electric field is applied locally. The selection of modes depends on the magnitudes of applied DC field intensity and oil-water interfacial tension. The growth of the squeezing mode leads to a time-periodic dripping of droplets at lower field intensities, whereas, bending mode develops into 'whiplash' ejection of miniaturized droplets having octuplet microvortices inside and outside, at higher field intensities. A transition from purely laminar flow is observed during the switch over to bending mode, resembling von Kármán vortex street formation. Use of alternating current (AC) electric field with variation in frequency and waveform is also found to create on-demand and time-periodic array of flow features following the mode selection.

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