Electronic Supplementary Information

Table s1 Threshold and splitting voltages of 20 and 50 cSt silicone oil droplets in different gap heights.

Gap height \ Voltage	Threshold		Splitting	
	20 cSt	50 cSt	20 cSt	50 cSt
75 μm	190 V	280 V	530 V	850 V
150 μm	250 V	310 V	720 V	1000 V
225 μm	300 V	350 V	950 V	1200 V

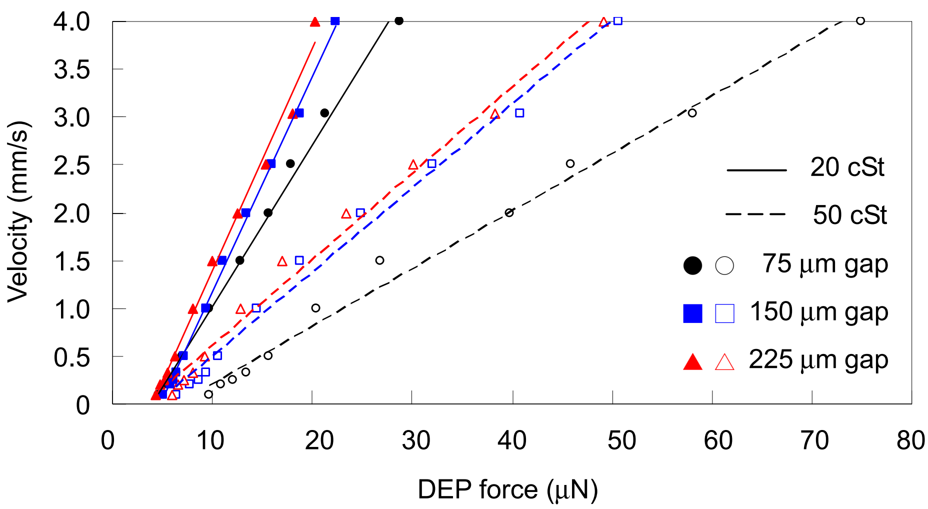

Fig. s1 Velocity curves of 20 and 50 cSt silicone oil droplets against DEP force in different gap heights. Solid lines and solid symbols: 20 cSt silicone oil; dashed lines and hollow symbols: 50 cSt silicone oil; circle symbol: 75 μm-high gap; square symbol: 150 μm-high gap; triangle symbol: 225 μm-high gap.

DEP force was obtained by closed surface Σ integral of the Maxwell stress tensor.[23,24]

$C_A = \frac{\varepsilon_A}{d}$, the specific capacitance of air

$C_{Oil} = \frac{\varepsilon_{Oil}}{t}$, the specific capacitance of oil

$C_D = \frac{\varepsilon_D}{t}$, the specific capacitance of the dielectric layer

$E_A = \frac{C_D}{C_A + C_D}\frac{V}{d}$, the electric field in air

$E_{D,A} = \frac{C_A}{C_A + C_D}\frac{V}{t}$, the electric field in the dielectric layer in series with air

$E_{Oil} = \frac{C_D}{C_{Oil} + C_D}\frac{V}{d}$, the electric field in oil

$E_{D,O} = \frac{C_{Oil}}{C_{Oil} + C_D}\frac{V}{t}$, the electric field in the dielectric layer in series with oil

The DEP force can be expressed by:

$$F_{DEP} = \left(-\frac{\varepsilon_0 \varepsilon_D E_{D,A}{}^2 t}{2} - \frac{\varepsilon_0 \varepsilon_A E_A{}^2 d}{2} + \frac{\varepsilon_0 \varepsilon_D E_{D,O}{}^2 t}{2} + \frac{\varepsilon_0 \varepsilon_{Oil} E_{Oil}{}^2 d}{2}\right) W ,$$

which can be further derived as eqn (2).