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

<table>
<thead>
<tr>
<th>Gap height</th>
<th>Voltage</th>
<th>Threshold 20 cSt</th>
<th>Threshold 50 cSt</th>
<th>Splitting 20 cSt</th>
<th>Splitting 50 cSt</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 µm</td>
<td></td>
<td>190 V</td>
<td>280 V</td>
<td>530 V</td>
<td>850 V</td>
</tr>
<tr>
<td>150 µm</td>
<td></td>
<td>250 V</td>
<td>310 V</td>
<td>720 V</td>
<td>1000 V</td>
</tr>
<tr>
<td>225 µm</td>
<td></td>
<td>300 V</td>
<td>350 V</td>
<td>950 V</td>
<td>1200 V</td>
</tr>
</tbody>
</table>

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 $\Sigma$ integral of the Maxwell stress tensor.\textsuperscript{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:

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

which can be further derived as eqn (2).