Electronic Supporting Information

Field Induced Anomalous Spreading, Oscillation, Ejection, Spinning, and Breaking of Oil Droplets on Strongly Slipping Water Surface

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Table SI: Physical properties of the experimental materials and fluid

<table>
<thead>
<tr>
<th>Properties</th>
<th>Water</th>
<th>Teflon</th>
<th>Silicon oil</th>
<th>Oleic acid</th>
<th>Hexadecane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dielectric constant (ε)</td>
<td>80</td>
<td>2</td>
<td>2.5</td>
<td>2.5</td>
<td>2.1</td>
</tr>
<tr>
<td>Surface tension (γ) (mN/m)</td>
<td>72</td>
<td>-</td>
<td>21</td>
<td>42</td>
<td>27</td>
</tr>
<tr>
<td>Interfacial tension (mN/m)</td>
<td>-</td>
<td>-</td>
<td>24</td>
<td>64</td>
<td>52</td>
</tr>
<tr>
<td>Density (kg/m³)</td>
<td>1000</td>
<td>-</td>
<td>971</td>
<td>895</td>
<td>770</td>
</tr>
<tr>
<td>Viscosity (Pa s)</td>
<td>0.001</td>
<td>-</td>
<td>0.33</td>
<td>0.027</td>
<td>0.003</td>
</tr>
<tr>
<td>Conductivity (μS/m)</td>
<td>5.6</td>
<td>-</td>
<td>0.8 ×10⁻⁶</td>
<td>10⁻⁶</td>
<td>10⁻⁶</td>
</tr>
</tbody>
</table>

Supporting Video 1. Expansion: The video shows the expansion or spreading of the oil droplet for the EWOL setup, as shown in Figure 1a. Here a 1 µl hexadecane droplet expanded on the water surface when we abruptly applied 500 V.
Supporting Video 2. Oscillation: The video shows the oscillation of an oil droplet on the EWOL setup shown in Figure 1b. Here a 1 µl of hexadecane droplet expanded and then oscillated on the water surface when we abruptly applied 550 V.

Supporting Video 3. Ejection: The video corresponds to the EWOL experimental setup shown in Figure 1c in which 1 µl of hexadecane droplet ejected out of the electric field when we abruptly applied the 800 V.

Supporting Video 4. Expansion, Oscillation and Ejection of droplet: The video shows simultaneous expansion, oscillation, and ejection of the oil droplet in the EWOL setup when the applied potential was progressively increased at a rate of 8 V/s.

Supporting Video 5. Clockwise and Anti-Clockwise Rotation: The video corresponds to the setup shown in the Figure 1d, where the EWOL experiments were conducted on a permanent magnet. The video shows clockwise and anticlockwise rotational motions with the change in the direction of the magnet.

Supporting Video 6. Droplet Breaking: The video corresponds to the EWOL experiments on a magnet, as schematically shown in the Figure 1d. In this situation, the spreading due to the rotation of the droplet and the shear at the oil-water interface led to the droplet breakup.

References