As pointed out in [36], the droplet dispensing process can be examined by the relationship of pressure difference occurs between the cutting electrode and reservoir electrode and/or cutting electrode and generating electrode. This pressure difference is a result of droplet deformation caused by EWOD force which relates droplet contact angle or applied voltage, and can be computed as [32]:

$$∆P\_{cr}=P\_{c}-P\_{r}=γ\_{LG}\left[\frac{1}{R\_{c}}-\frac{1}{R\_{r}}+\frac{ε\_{0}εV\_{r}^{2}}{2γ\_{LG}t}\frac{1}{d}\right] (01)$$

$$∆P\_{cg}=P\_{c}-P\_{g}=γ\_{LG}\left[\frac{1}{R\_{c}}-\frac{1}{R\_{g}}+\frac{ε\_{0}εV\_{g}^{2}}{2γ\_{LG}t}\frac{1}{d}\right] (02)$$

where, $∆P\_{cr}$ and $∆P\_{cg}$ indicates the pressure difference between the cutting electrode and the reservoir, and cutting electrode and generating electrode, respectively, *Rc,r,g* the radius of curvature of each meniscus on the cutting electrode, reservoir and generating electrode, respectively, *Vr,g* applied electric potential to the reservoir and generating electrodes, respectively, and $γ\_{LG}$ the liquid-gas interfacial tension. We extend Gong et. al.’s [32] analysis to enhance the volume accuracy of the dispensed droplet by reducing the cutting length (i.e., liquid tail). As indicated by Cho et. al. [31], the radius of curvature of the meniscus is determined by the electrode size over which the meniscus is confined which results in larger radius of curvature of the meniscus on larger electrodes. According to Figure 1, $R\_{g}<R\_{r}$. Thus:

$$ \left(\frac{1}{R\_{c}}-\frac{1}{R\_{g}} \right)<\left(\frac{1}{R\_{c}}-\frac{1}{R\_{r}} \right) (03)$$

Note that the dewetting meniscus is a saddle surface which has one positive radius of curvature (r) and one negative curvature (*Rc*). Above relationship shows that the pressure difference induced between the cutting electrode and the reservoir should be larger than the pressure difference induced between the cutting electrode and generating electrode ($0<∆P\_{cg}<∆P\_{cr}$) while maximum pressure occurs over the cutting electrode ($P\_{c}>P\_{g}>P\_{r}$).

Additionally, if the applied electric potential is higher enough for the pinch-off, the minimum possible value of the radius of the curvature over the cutting electrode can be approximated to half the size of the cutting length ($R\_{0}=\left|R\_{c}\right| \_{min}={l\_{0}}/{2}$) [32]. To achieve higher volume accuracy, the cutting length should be reduced in order to minimize the liquid tail which in turn decreases the $R\_{0}$. Figure A1 shows the plot of $∆P\_{cr}$ and $∆P\_{cg}$ given by equation (1) and (2) for different minimum possible value of radius of curvature ($R\_{0}$) over the cutting electrode achieved by reducing the cutting length ($x\_{c}<l\_{0}$). Let’s assume side length of the generating electrode ($l\_{0}$) be 2 mm, and side length of the reservoir electrode is three times longer than that of the generating electrode. Thus, $R\_{g} $can be approximated to (${l\_{0}}/{2)}$ = 1 mm and $R\_{r}$ to (${3l\_{0}}/{2)}$ = 3 mm. Refer to Table A1 for values of each constant parameter.



**Figure S1.** Variation of pressure difference between different regions of the droplet during pinch-off when reducing the cutting length ($x\_{c}<l\_{0})$. Blue colored curve represents the pressure difference between the cutting electrode and generating electrode ($∆P\_{cg})$. Red colored curve represents the pressure difference between the cutting electrode and the reservoir $(∆P\_{cr})$.

According to Figure A1, when $R\_{0}$ is reduced, $∆P\_{cg}$ decreases. However, when $∆P\_{cg}$ approaches to zero ($R\_{0}=0.3846×10^{-3} m$), according to equation (2), the electrowetting force can no longer exceed the pressure gradient caused by the variation of curvatures between the cutting and generating electrode, which results in stopping neck formation and pinch-off [36]. Since $∆P\_{cr}$ is still positive at this instance ($∆P\_{cr}=47.9933 Pa$), the entire contents of the finger front is pulled out into the reservoir without dispensing a droplet. Therefore, the minimum cutting length $((x\_{c})\_{min}$) should be 2(0.0003846) m = 0.7692 mm. The Laplace pressure drop across the dewetting meniscus on the cutting electrode is given by:

$$ ∆P\_{L}=γ\_{LG}\left[\frac{1}{r}+\frac{1}{R\_{c}}\right]=γ\_{LG}\left[\frac{1}{r}-\frac{1}{|R\_{c}|}\right] (04) $$

According to equation (4), the Laplace pressure drop across the dewetting meniscus corresponding to the minimum cutting length $((x\_{c})\_{min} $= 0.7692 mm) is given by = 444.3097 Pa. Positive radius of curvature (r) of the dewetting meniscus is calculated from the geometry.

**Table S1.** Values ofconstant parameters appeared in the equations (1-4)

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Unit** |
| $$γ\_{LG}$$ | 0.07199 | N/m |
| *d* | 100 | $$μm$$ |
| *Vr,g* | 150 | V |
| $$θ$$ | 116 | degrees |
| *t* | 7 | $$μm$$ |
| $$ϵ\_{0}$$ | $$8.85×10^{-12}$$ | $$F/m$$ |
| $$ϵ$$ | 4.1 |  |
| $$r$$ | 114 |  $μm$ |
| $$ρ$$ | 996.93 | Kg/$m^{3}$ |
| $$μ$$ | 0.89 | g/ (m.s) |

Reference

[36] Song JH, Evans ER, Lin EYY, Hsu EBN, Fair RB (2009) A scaling model for electrowetting-on-dielectric microfluidic Actuators. J Microfluid Nanofluid 7(1), 75–89. doi 10.1007/s10404-008-0360-y