**Supporting information**

# Separation of floating oil drops based on drop-liquid substrate interfacial tension

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# Supplementary text

## Text S1. Experimental analysis of droplet dynamics in the "attraction regime"

Here we select only the *attraction regime* of both kind of oils (*TYPE A* and *TYPE B*) and analyze their velocity profile of bubble induced capillary transport with respect to mainly two parameters; surfactant concentration and drop volume. The drops are placed at a maximum distance from the bubble center up to which capillary interaction force extend (by trial and error method). When the bubble is created, drops are pulled in radially towards the bubble center. The videos of bubble induced droplet motion are taken using a top view movie camera and processed using the software ImageJ to obtain the velocity profiles of drops. In all the experiments, the bubble diameter was kept approximately same (5mm). Irrespective of the drop type, volume or surfactant concentration the velocity profiles shows similar behavior. Initially the drops move very slowly, but the velocity increases steadily with distance as the drops moves further in and attains a maximum value at the periphery of the bubble. This can be understood in accordance with the curvature profile of the bubble induced surface deformation. Curvature of the bubble induced deformation is maximum at the bubble center and gradually reduces outwards. [1] Therefore a drop far away from the bubble experiences less capillary force compared to its inertia. But the capillary force increases as the drop moves radially towards the higher curvature regions. **Supporting Figure S1 (A)** depicts the velocity profiles for three different surfactant concentrations for the TYPE B (keeping volume same).

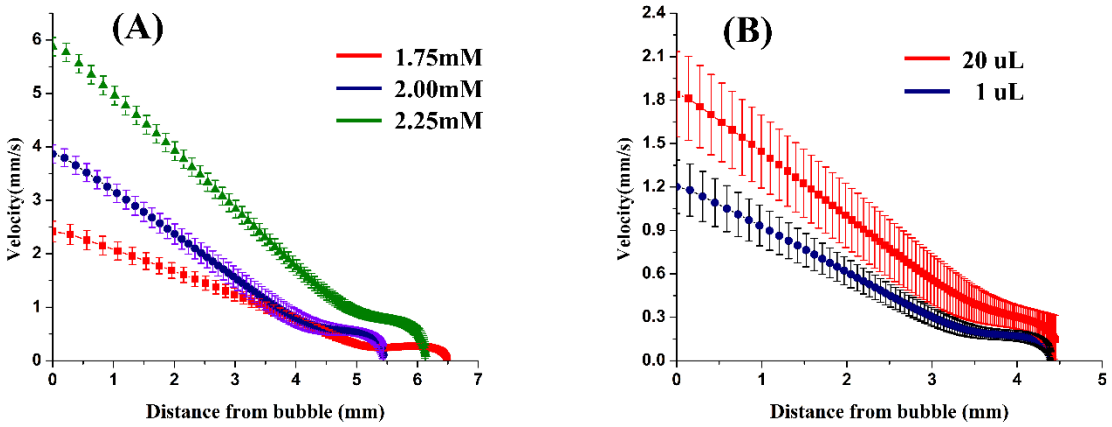


**Figure S1**. Velocity profiles of bubble induced droplet attraction. (A) Velocity profiles corresponding to different concentration of surfactant (TYPE B; Volume kept same at 5μL). (B) Velocity profiles corresponding to different droplet volume (TYPE A; Surfactant concentration kept same at 3.5mM). Error bar from four trials each.

As the surfactant concentration increases, the slopes of the velocity profile increase and drops are accelerated to higher velocities. From **figure 1 (A)** of the main text, it is evident that interfacial tension (IFT) of drops decreases with increase in surfactant concentration. Lower the IFT, steeper will be the meniscus created by the drops thereby enhancing the capillary curvature forces resulting in an increased acceleration. To find impact of droplet volume on the bubble directed droplet motion, various droplet volumes ranging from 1 to 20 μL were plotted keeping the surfactant concentration same. Supporting Figure S1 (B) show a representative data for TYPE A. For very small volume drops, the portion of the drop above the interface will too less to benefit from the meniscus formation. For bigger drops, the meniscus can grow to full height as there is sufficient portion of drop protrudes out from the mean interface level. Therefore the interface deformation created by bigger drops will be more very small drops. Thus the curvature

forces will impart a higher acceleration on big drops. It was found that drop volumes as high as 50μL can be attracted from a distance of about 5mm from the bubble. Higher the droplet volume, smaller will be the range from which they can be attracted. This is evident from the interplay of capillary curvature forces and inertia. The curvature force experienced by bigger drops is not sufficient to overcome their inertia, if they are outside a particular range.

### References.

(1) Vinay, T. V.; Banuprasad, T. N.; George, S. D.; Varghese, S.; Varanakkottu, S. N. Additive-Free Tunable Transport and Assembly of Floating Objects at Water-Air Interface Using Bubble-Mediated Capillary Forces. Advanced Materials Interfaces 2017, 4 (7), 1601231. https://doi.org/10.1002/admi.201601231

## Legends of the movies

**Movie S1. Interaction of *TYPE A* drop with bubble at low Surfactant concentration.** SDBS concentration is 1.5 mM. A *TYPE A* drop of 5μL volume is placed near to the bubble center and bubble is created. The video is displayed at actual speed.

**Movie S2. Interaction of *TYPE A* drop with bubble at high Surfactant concentration.** SDBS concentration is 3.0 mM. A *TYPE A* drop of 5μL volume is placed away from the bubble center and bubble is created. The video is displayed at actual speed.

**Movie S3. Interaction of *TYPE B* drop with bubble at low Surfactant concentration.** SDBS concentration is 0.5 mM. *TYPE B* drop of 5μL volume is placed near to the bubble center and bubble is created. The video is displayed at actual speed.

**Movie S4. Interaction of *TYPE B* drop with bubble at high Surfactant concentration.** SDBS concentration is 2.0 mM. *TYPE B* drop of 5μL volume is placed away from the bubble center and bubble is created. The video is displayed at actual speed.

**Movie S5. Microbubble interaction with drop at low Surfactant concentration.**

At a surfactant concentration of 1.5 mM, a microbubble of ~300μm diameter is released near a *TYPE A* drop. The microbubble is highlighted using yellow arrow. The video is displayed two times the actual speed.

**Movie S6. Microbubble interaction with drop at high Surfactant concentration.**

At a surfactant concentration of 3.0 mM, a microbubble of ~300μm diameter is released away from a *TYPE A* drop. The microbubble is highlighted using yellow arrow. The video is displayed two times the actual speed.

**Movie S7. Repulsion regime.** At a surfactant concentration of 0.5 mM, *TYPE A* and *TYPE B* drops are placed near to the bubble center and bubble is created. The video is displayed at actual speed.

**Movie S8. Separation regime.** At a surfactant concentration of 1.5 mM, initially, *TYPE A* drop is placed near to the bubble center while *TYPE B* drop is placed away from bubble center and bubble is created. The video is displayed at actual speed.

**Movie S9. Attraction regime.** At a surfactant concentration of 2.5 mM, *TYPE A* and *TYPE B* drops are placed away from the bubble center and bubble is created. The video is displayed at actual speed.