TRANSPORT OF AQUEOUS DROPLET PLACED OVER OIL BASED FERROFLUID SPIKES IN PRESENCE OF A MAGNETIC FIELD

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Droplets can be used as carrier vehicles for the transportation of biological and chemical reagents[1]. Magnetic field based manipulation being non-contact and biocompatible can be advantageous over other active manipulation techniques. An oil based ferrofluid splits into array of spikes due to the presence of a vertical magnetic field[2]. We report the transportation of aqueous droplets over oil-based ferrofluid spikes in presence of a magnetic field. Our study reveals that transportation phenomena is governed by the interplay of three different forces – magnetic force F_m, frictional force F_f and interfacial tension F_i, which is expressed in terms of the force ratios, $k_m = (F_f/F_m)$ and $k_i = (F_f/F_i)$. Based on the values of the force ratios k_m and k_i, three different regimes – steady droplet transport, spike extraction and magnet disengagement, are identified. It was found that steady droplet transport is observed for $k_m \leq 1$ and $k_i \leq 1$, whereas extraction of spikes is observed for $k_m \leq 1$ and $k_i > 1$, and magnet disengagement is observed for $k_m > 1$. In the steady droplet transport regime, velocity of the aqueous droplet U_{ds} was found to be dependent on the volumes of the aqueous droplet V_w and FF droplet V_{FF}. In the spike extraction regime, the spike extraction distance L_{se} was found to vary with V_w, V_{FF} and the magnet velocity U_{ms}.

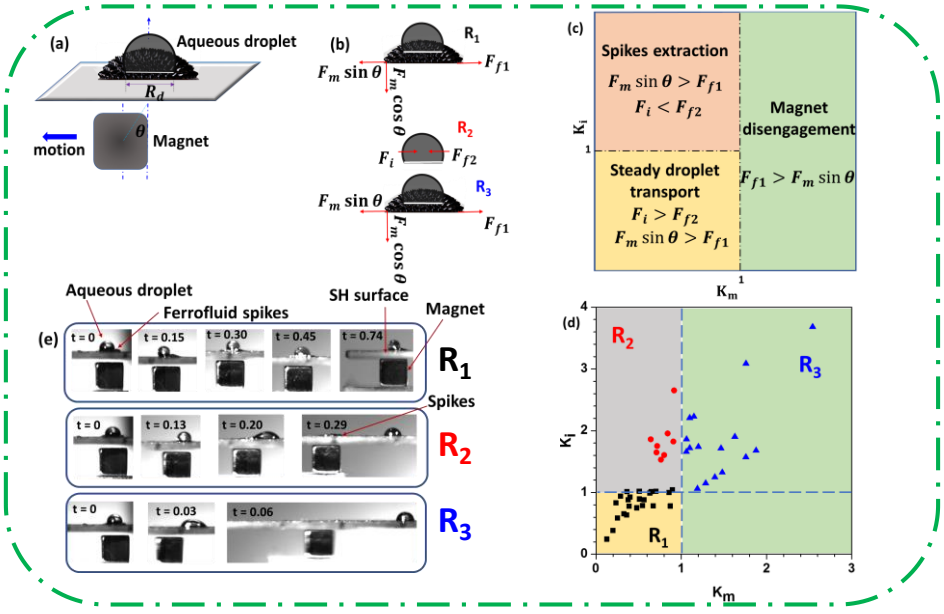

Figure 1 (a) Schematic of the experimental setup, (b) Force analysis, (c) Regimes of droplet transport, (d) Regimes obtained from experimental data, (e) Experimental images of various regimes

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