Supplementary information for Light-switchable deposits from evaporating drops containing motile microalgae

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Drop shape analysis

To measure the time-dependent contact angle of a drop containing *Chlamydomonas reinhardtii* (*C. R.*) deposited on a glass slide, we used a Drop Shape Analyzer from Krüss. For the measurements, we deposited 0.3 µl of a drop containing algae on a silanized glass slide and monitored the evaporation every 5 seconds. This allows to extract information on both contact angle and contact radius during the evaporation (Fig. S1). We observe that the contact angle decreases, while the contact radius remains constant. The drop is pinned to the glass slide during the whole drying process.

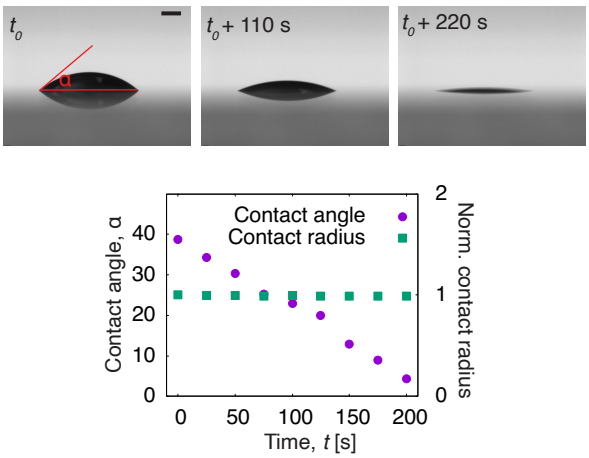

FIG. S1. Drop shape analysis of a drop containing microalgae. The drop remains pinned during the evaporation process with a steadily decreasing contact angle. Scale bar is 300 µm.

Experimental setup

The experimental setup we used is schematically illustrated in Fig. S2. Small drops of motile *C. R* were deposited on silanized glass slides and left to dry. The evaporation process was monitored using an inverted phase contrast microscope. During evaporation the algae drops were illuminated with either white or red light from above, or white light from the side.

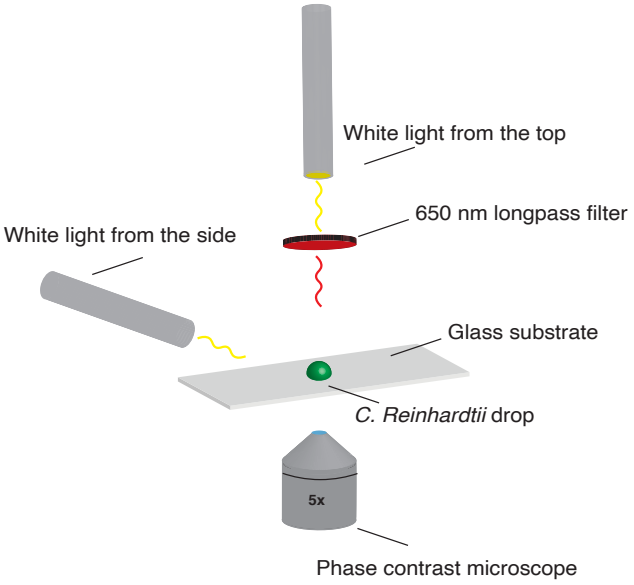

FIG. S2. Illustration of the experimental setup used in this work.

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Rectangular intensity profiles

Rectangular intensity profiles of $\approx 1600 \times 400\,\mu m$ were calculated using the image analysis software ImageJ [1] for all final deposits to emphasize the presence or absence of algal rings (Fig. S3).

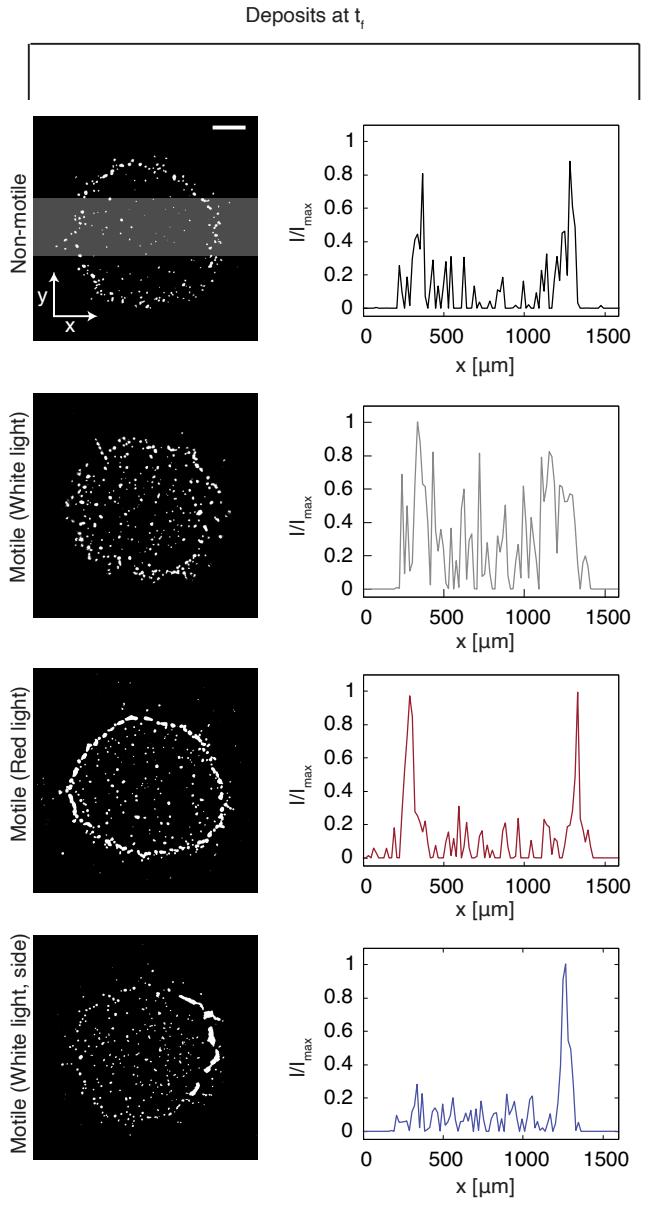

FIG. S3. Rectangular intensity profiles of the final deposits of drops containing active *C. R.*. The grey area highlights the analysed section for the corresponding rectangular intensity profiles on the right. Scale bar is 250 µm

Concentration dependence of the ring formation

The magnitude of the deposits increases with the initial concentration of algae within the drops. We confirmed this in a reference measurement for the non-motile case, in which we changed the initial concentration of the algae present in the drops (Fig. S4).

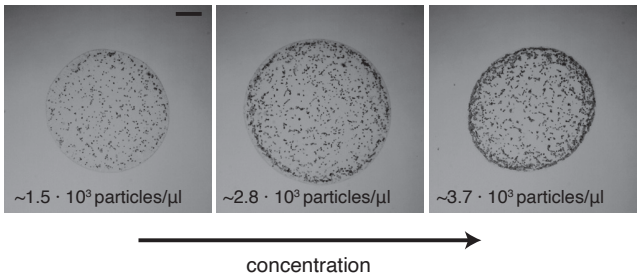

FIG. S4. The ring-like deposit on the drop periphery increases with the inital concentration of algae. Scale bar is 100 µm.

Density profiles

From the PTV measurements we obtained density maps showing the distribution of algae within the drying drops at different time steps under different light conditions (Fig. S5). The data show that active algae accumulate at the contact line during the late stages of evaporation when illuminated with red light from above. This effect is not observed when illuminated with white light instead.

Ring formation in the red light case

In the red light case we observed that algae aggregate at the contact line in the later stages of evaporation (Fig. S5, Fig. 5), which eventually led to the ring-like deposit shown in Fig. 1c. To verify our hypothesis, that the algae get trapped at the contact line at a critical contact angle α_c, we carried out a separate drop shape analysis and bright-field microscopy experiment on a large 5 µl drop deposited on an untreated glass slide, which exhibits a lower initial contact angle of $\approx 15°$ (Fig. S6) instead of $\approx 40°$ (Fig. S1). We observed that, although the contact angle remains constant within the time frame of the experiment, the algae aggregate at the contact line. This confirms our assumption that the algae get trapped if the contact angle reaches below a critical contact angle α_c. The more pronounced ring in the red-light case as compared to the non-motile case is due to variations in the concentration of algae cells within the drops.

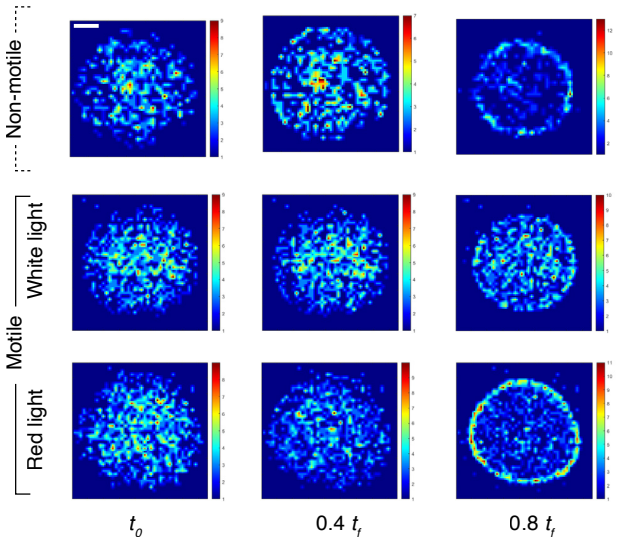

FIG. S5. Density maps obtained from the PTV measurements show the spatial distribution of *C. R.* for 3 time steps under different light conditions. Evidently, the algae accumulate at the contact line when illuminated with red light, but remain homogeneously distributed in the white light case. Scale bar is 300 µm.

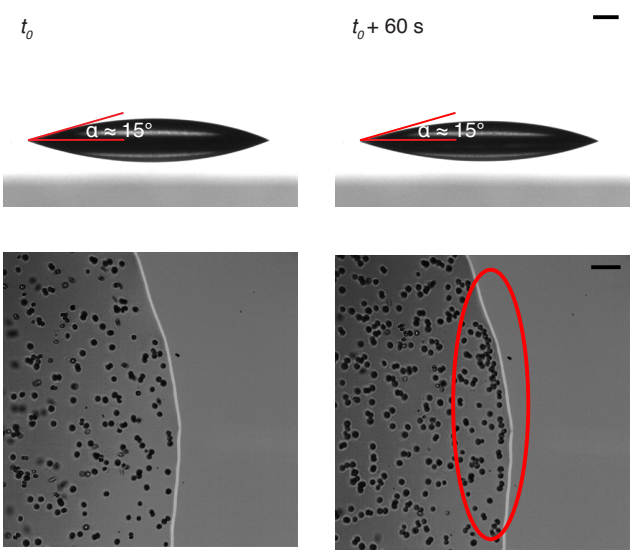

FIG. S6. Drop shape analysis (top) and bright-field microscopy images (bottom) of the first minute of a large drying drop (5 µl) on an untreated surface. The small contact angle of ≈ 15° causes the algae to get trapped at the contact line. Scale bars are 50 µm.

[1] C. Schneider, W. Rasband and K. Eliceiri, *Nature Methods*, 2012, **9**,.