Electronic Supplementary Material (ESI) for Green Chemistry.

Supplementary Information

Hydrothermal disruption of algae cells for astaxanthin extraction

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The experimental apparatus is adapted from our previous research with slight modification upstream of the microfluidic reactor. The algae solution, chemicals and solvent stored within piston cylinders [2a & 2b] were separately injected into the microfluidic reactor by controlling the switching valve [3a]. Switching valve [3b] was fixed at position 1 until the solvent extraction stage. After 1 min of solvent extraction, the switching valve [3b] was quickly switched to position 2 to unload the extracted astaxanthin to the fixed-volume sample isolator.

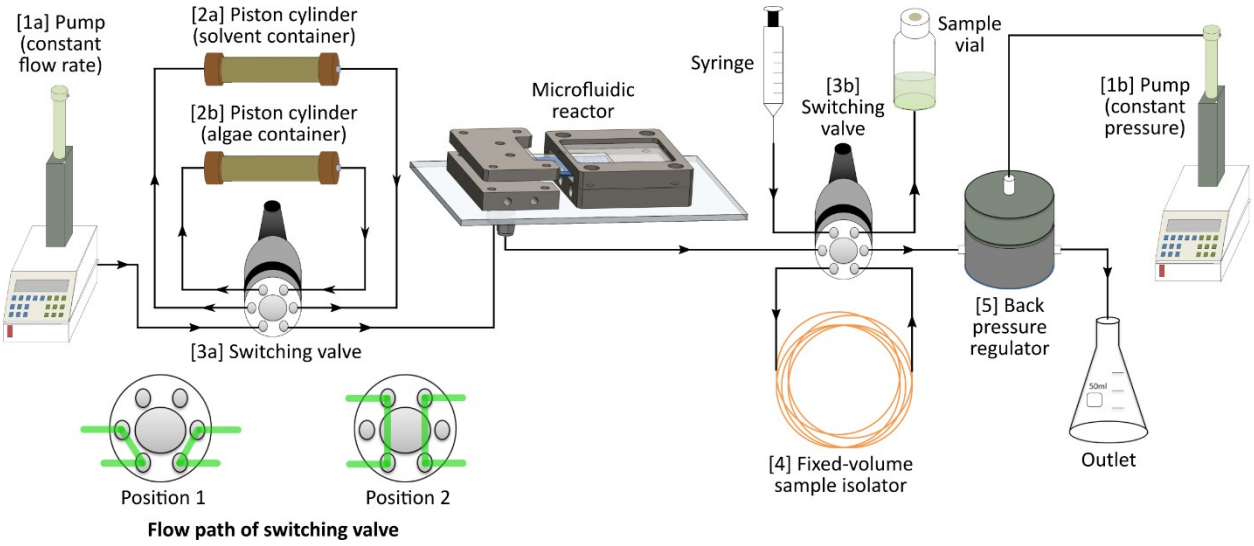

Fig. S1 Schematic diagram of the experimental setup with flow direction indicated by arrows along the processing path. The flow path of the switching valve at two positions is shown using green lines.

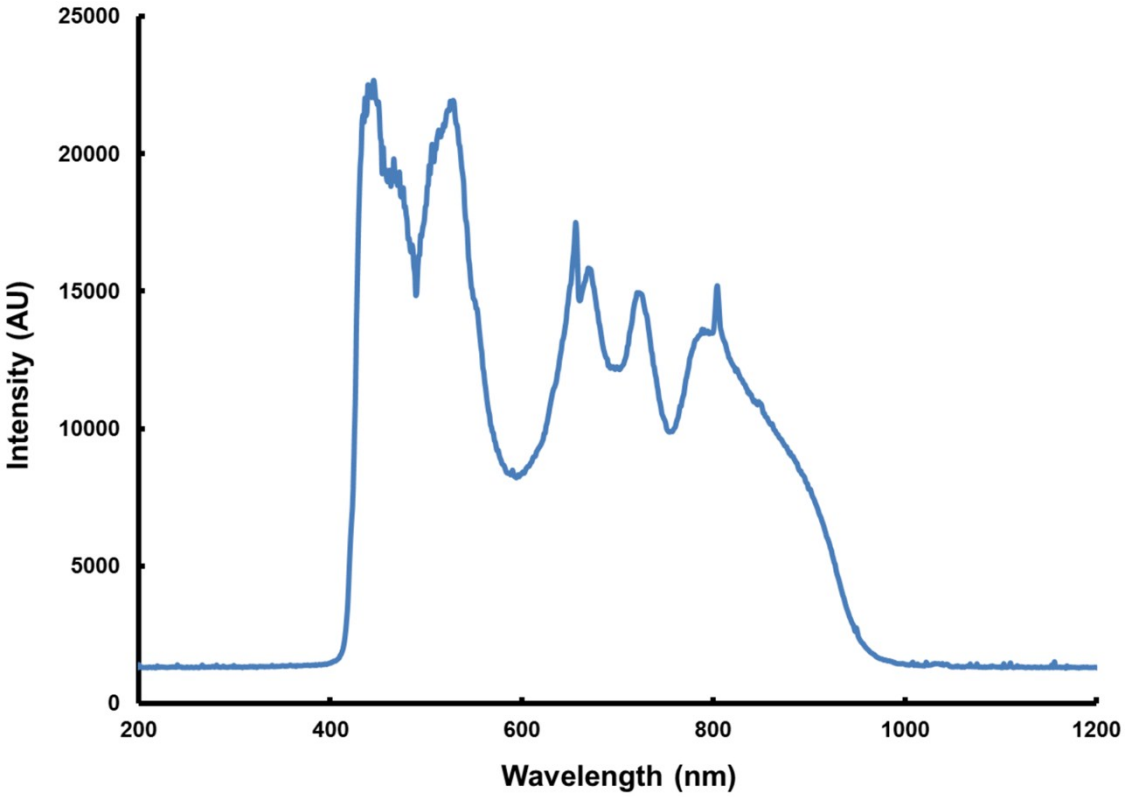

Fig. S2: Irradiation spectrum of light used to induce astaxanthin accumulation in *Haematococcus pluvialis.*

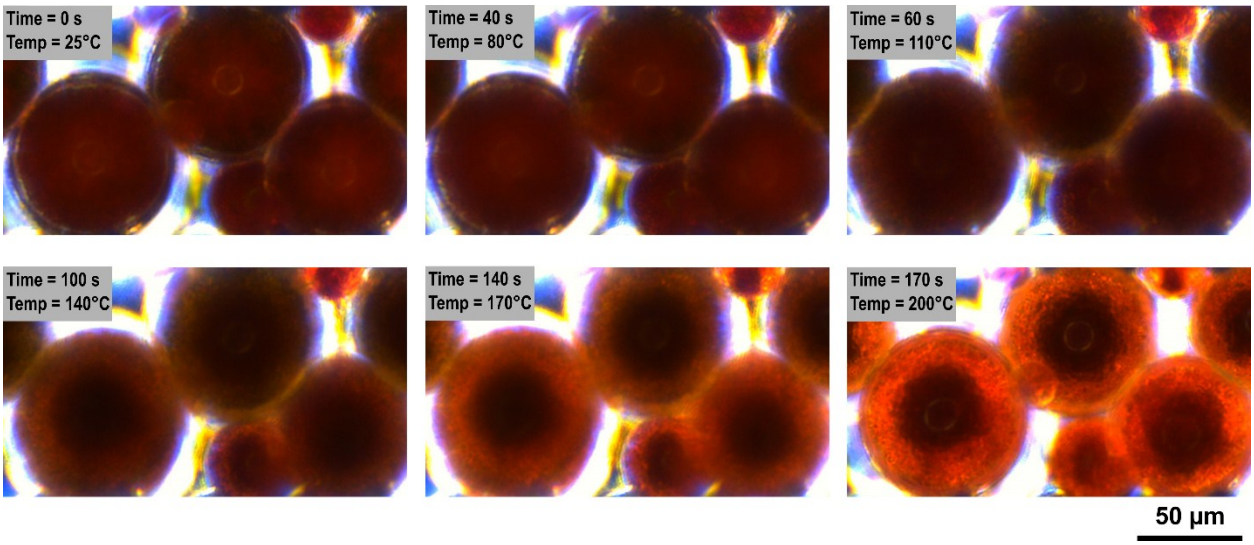

Figure S3: Microscope images of red cysts, indicating coloration change during the heating up phase in the hydrothermal disruption process. The scale bar applies to all images.

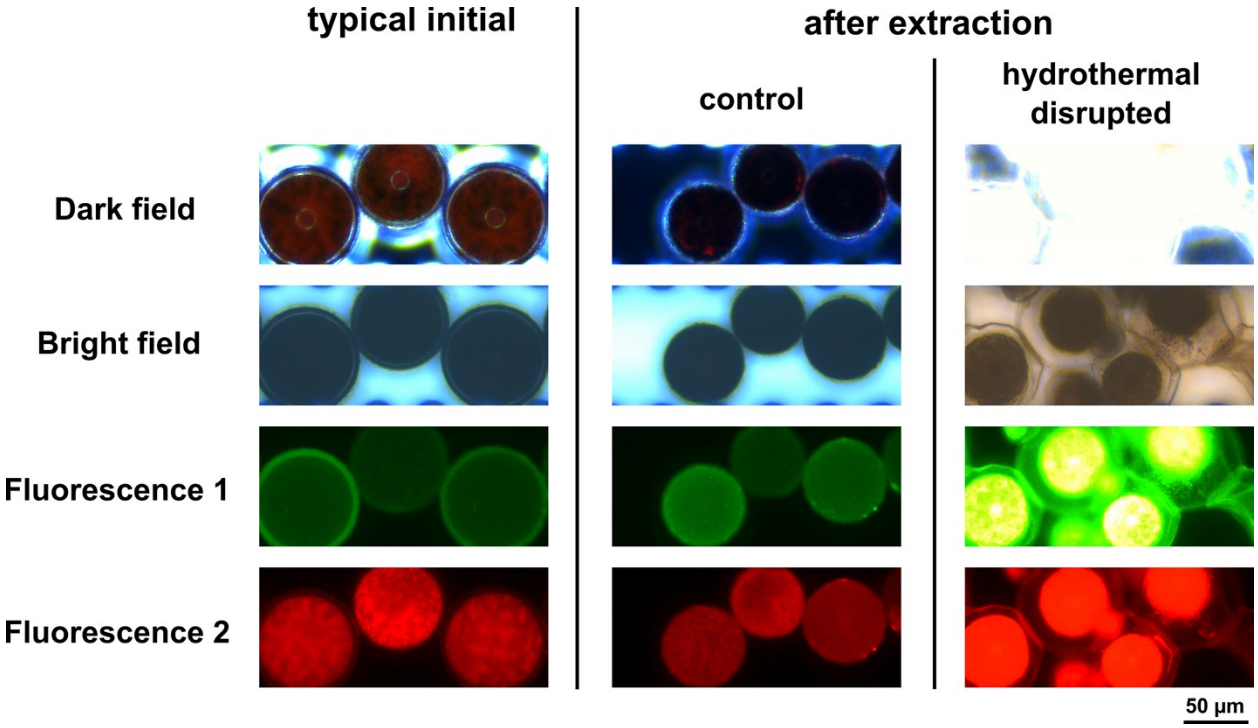

Figure S4: Dark field, bright field and fluorescence images of initial cells and after acetone extraction. Fluorescence 1 and 2 images were taken using FITC (excitation filter: 475/50 nm; emission filter: 540/50 nm) and TxRed (excitation filter: 559/34 nm; emission filter: 630/69 nm) filter cubes respectively. The scale bar of 50 µm applies to all images.

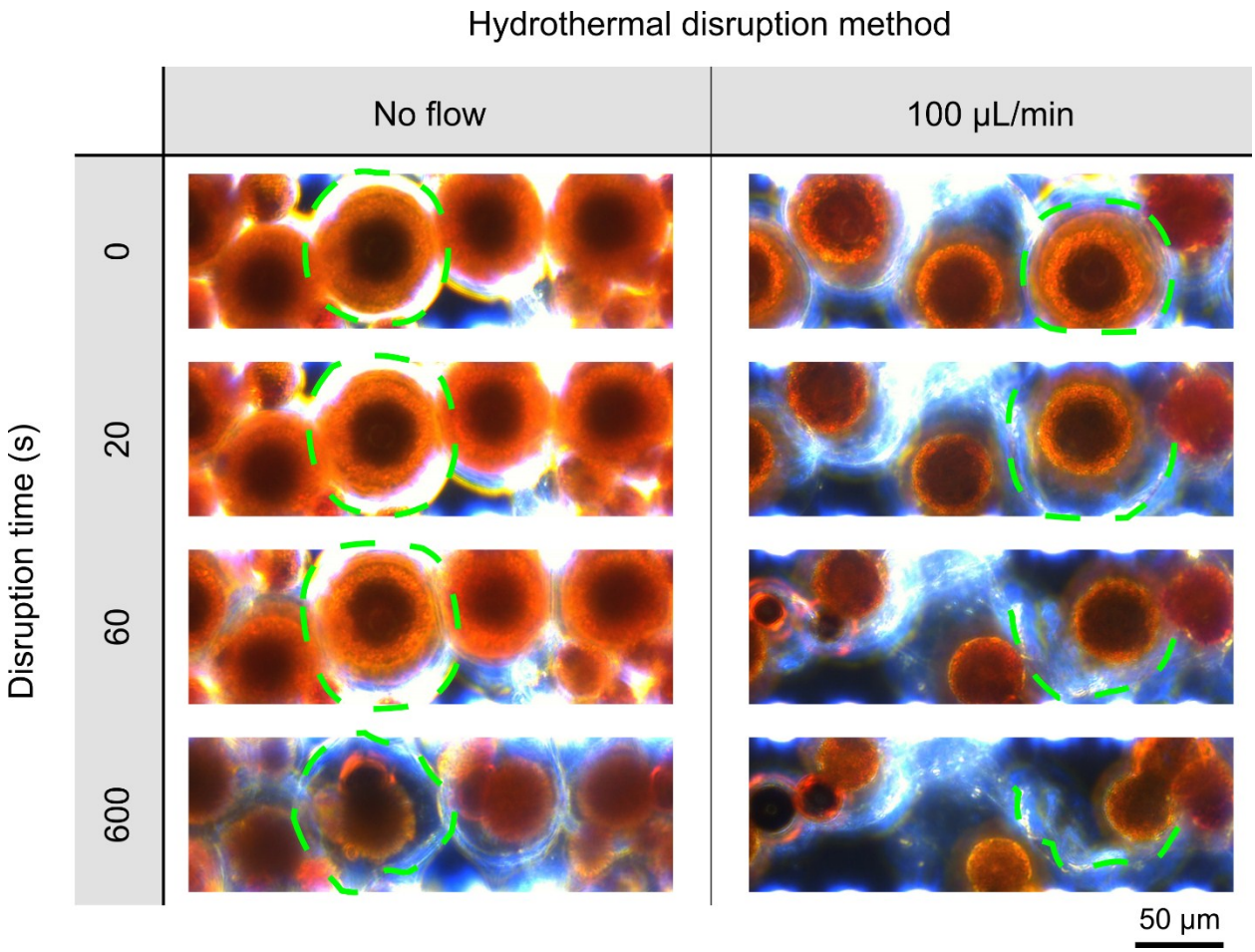

Figure S5: Cell wall deformation of red cysts under hydrothermal processes at 200 °C in 10 min with and without flow. Green dashed lines indicate cell wall boundaries. The scale bar of 50 µm applies to all images.

Video S1: Real-time video showing *H. pluvialis* cells being trapped by posts in a microfluidic channel. Cells in this video were not fully transformed into mature red cysts and are here used as a demonstration.

Video S2: Real-time video showing the *in-situ* acetone extraction of red cysts of *H. pluvialis* treated by hydrothermal disruption at a temperature of 150 °C and pressure of 6 MPa for 30 min.

Video S3: Real-time video showing the *in-situ* acetone extraction of red cysts of *H. pluvialis* treated by hydrothermal disruption at a temperature of 200 °C and pressure of 6 Mpa for 10 min.