Microdroplet-based screening system for selection of fast-growing microalgal strains from a mutant library

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Microalgae have received great attention for biological conversion of CO_2. For the commercial use of microalgae, it is necessary to screen highly-productive algal strains. In this study, we introduced microdroplet-based microfluidic system to screen the fast-growing strains from a mutant library. To utilize microdroplet as a photobioreactor, the transparent and gas-permeable polydimethylsiloxane (PDMS) was used for the supplementation of CO_2 and light essential for photoautotrophic cultivation of microalgae. To isolate the algal strains showing high growth rate in droplet, the density-based magnetophoretic sorting system was developed. When the magnetic field was applied to droplets containing magnetic nanoparticles, magnetic droplets could be attracted toward the magnet with different acceleration according to the density. Consequently, we could obtain the mutant strain having improved biomass productivity with a high probability (> 90%). These microdroplet-based screening approaches provide powerful strategies to improve the disadvantages of conventional screening methods which are costly, labor intensive, and time-consuming.