Abstract
The feasibility of producing pure photosynthetic cell biomass heterotrophically and activating their photosynthetic apparatus through light illumination was investigated using Chlorella sorokiniana and Euglena gracilis. Although the chlorophyll contents of Chlorella and especially Euglena cells decreased during heterotrophic cultivation, photoactivation of the cells resulted in sharp increases in their chlorophyll and some other metabolites contents. Furthermore, the cells swiftly changed from heterotrophic to photoautotrophic metabolism and vice versa, when the culture conditions were cyclically changed from heterotrophic to photoautotrophic. Under this condition, the cells grew continuously and, depending on the light condition during the photoautotrophic phase, there was a stable fluctuation in the intracellular metabolites concentrations. In the case of Chlorella, for example, the protein content of the cells decreased during the heterotrophic phase and then increased during the photoautotrophic phase. The results implied that the cells retained their photosynthetic apparatus during the heterotrophic cultivation and can be easily activated by illuminating the culture.An internally illuminated photobioreactor, which can be used for both heterotrophic cultivation and photoactivation of the cells was therefore constructed. Using this reactor, the cells are first cultivated heterotrophically to a high cell concentration and when the organic carbon source is completely exhausted, the reactor is illuminated for photoactivation of the cells. The photobioreactor has high mass transfer capacity (for efficient heterotrophic culture) and high light supply capacity (for efficient photoactivation). It can be illuminated by both artificial and solar light, can be maintained under strict sterile condition and easy to be scaled up.