Cyanobacteria as a novel biocatalyst for photobiocatalytic H_2 production

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To date, commercial H_2 production is predominantly produced from fossil fuel using thermochemical methods with harmful impact against global environment. Among the existing technology, solar-to-chemical energy conversion is one of the ultimate goal for clean energy resource. According to the objectives and research effort of Project 2-1 of our division during 2014-2020, we has been focusing on the optimization of photocatalysts and the application of hydrogenase for H_2 production. Photobiocatalysis has been attractive due to its flexibility, low energy cost, and eco-friendly characteristics. Therefore, this work aims to couple a metal oxide P-25 as a light energy-absorbing photocatalyst to [NiFe]-hydrogenase expressing cyanobacteria as an O_2-tolerant biocatalyst for photobiocatalytic H_2 production. This study was performed in the complete system including four components: 1) 50 mg of P-25, 2) 5 mg of cyanobacteria, 3) 1 M TEOA-HCl pH 7.4 as a sacrificial reagent and 4) 2.5 mM methyl viologen an electron mediator. *Anabaena variabilis* is a filamentous cyanobacteria encoding bidirectional hydrogenase with NiFe at active side of HoxH subunit and also known as O_2-tolerant hydrogenase. At 3 h after illumination, the amount of H_2 rise to 349.8 µmol higher than the system without photocatalyst and sacrificial reagent. However, the efficiency of wild-type cyanobacteria is still lower than that of recombinant *E. coli* expressing [FeFe]-hydrogenase. The influence of sacrificial electron donor was also carried out in various concentrations of TEOA from 0.25 to 1 mM. It was found that the rates and amounts of H_2 production significantly increase corresponding to the amounts of electrons donated from TEOA. The achievement of this study is to provide an alternative technique to overcome a major obstacle of O_2 sensitivity that considerably necessary for low-cost application of industrial-scale H_2 production from renewable resource without CO_2 emission.