Discovery of an Alternative Oxygen Sensitivity In Algal Photosynthetic H_2 Production

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Abstract

Algal photosynthetic hydrogen (H_2) production is a potential future clean energy resource. In green algae, photoevolution of H_2 and O_2 occurs in the same cell where the photosynthetically produced O_2 can inhibit the production of H_2. Therefore, application of green algae for H_2 production is confronted with the problem of oxygen sensitivity. In the past, this O_2-sensitive phenomenon was generally interpreted as the O_2-inhibition effect on hydrogenase activity. Recently, we discovered that this classic interpretation of O_2 sensitivity needs to be revised. In this presentation, we report latest experimental studies on this finding. In our recent experiments that characterized O_2-tolerance in H_2-producing wild-type *Chlamydomonas reinhardtii*, we observed a new oxygen sensitivity that is clearly distinct from the oxygen sensitivity of the hydrogenase. This distinct O_2 sensitivity indicates that there is an alternative electron transport pathway that can take electrons away from the hydrogenase-catalyzed H_2 production pathway to O_2. Our experiments demonstrated that this alternative mechanism is more sensitive to O_2 than the oxygen sensitivity of the hydrogenase. Addition of a proton uncoupler (FCCP) can reverse the O_2-inhibition effect and restore H_2 production. Therefore, these findings represent an important progress in algal H_2 production research. Future work will focus on mapping this alternative electron transport pathway and on developing a technique to control this pathway to enhance the production of H_2.