Cyanobacteria, the future producer of the energy carrier H_2 from sun & water – A biotechnological challenge

Peter Lindblad. Dept Physiological Botany, EGS, Ångström Laboratory, Uppsala university, Box 523, SE-751 20 Uppsala, Sweden.
Tel: +46 - 18 471 28 26; E-mail: Peter.Lindblad@ebc.uu.se

Molecular hydrogen (H_2) is an environmentally clean energy-carrier that may be a valuable alternative to the limited fossil fuel resources of today. In addition, when used in combination with fuel cells only electricity and water are formed. A key question is the production of H_2. In nature, cyanobacteria and green algae have the capacities to collect solar energy and split water into electrons and protons (photosynthesis) as well as produce H_2 from electrons and water.

Cyanobacteria may possess several enzymes directly involved in hydrogen metabolism: (a) nitrogenase, evolving H_2 concomitantly with the conversion of molecular nitrogen into ammonia, (b) an uptake hydrogenase, reutilizing the H_2 produced during N_2-fixation, and, (c) a bidirectional hydrogenase. Cyanobacteria can be used in bioreactors for the photobiological conversion of water to hydrogen. However, the conversion efficiencies achieved are low. Improvements are achieved through: a) the elimination of the capacity to take up H_2, b) increased H_2 production (using several different strategies), c) a more direct use of obtained electrons for H_2 production and e.g. not growth, and d) the development of more efficient bioreactors.

Suggested projects are (i) Regulation of key enzymes in the hydrogen metabolism of cyanobacteria (both structural components and proteins involved in the maturation process, (ii) Introduction of foreign hydrogenases into cyanobacteria, (iii) Bioreactor design, and (iv) Characterisation of existing genetically engineered cyanobacteria. You will be part of the National project *Artificial Photosynthesis* aiming at a renewable production of H_2 from solar energy using natural or artificial systems. We are localised in new, purpose-designed facilities at the Ångström Laboratory.