# PhotoSomes

## Motivation

Since the rise of the industrial age, atmospheric $CO_2$ levels are increasing due to the rise in energy consumption of the human population. As generally known, one of the major consequences is the inevitably resulting climate change (Yoro & Daramola, 2020). To circumvent global warming, renewable energies using modern technologies are of utmost importance.

Next to solar energy, wind and water power, renewably produced hydrogen will play a crucial role in the transition from fossil to green energy production. Nowadays, hydrogen is produced in energy intensive processes and mostly based on the usage of fossil energy sources. Thus, the search for alternative and innovative ways for a sustainable production of hydrogen is fundamental to a greener future (Nikolaidis & Poullikkas, 2017).

## Goal

PhotoSomes combines the words "photosynthesis" and "liposomes" and describes the product we want to develop: Liposomes as mini-reactors powered by sunlight.

Photosynthesis is one of the most fundamental processes in nature which harvests the energy of the sun, ultimately using it for the biogenesis of carbohydrates. Biological photo-enzymes, photosystem II and I, are membrane-integrated redox-enzymes used by cyanobacteria, algae or plants for oxygenic photosynthesis(Nickelsen & Rengstl, 2013). They harvest sunlight, use photoexcited electrons to split water and obtain energy for further chemical reactions. In nature, these organisms use the energy for ATP and NADPH production, but for isolated photo-enzymes, this energy can be used to power different chemical redox-reactions(Mersch et al., 2015; Stirbet et al., 2020). Semi-artificial photosynthesis was already demonstrated for $H_2$ production with a conventional two-electrode setup (Mersch et al., 2015).

Goal of our research is to utilize this light-induced process and redirect the energy flow of photosynthesis into the production of green, sustainable hydrogen. One major challenge is the competition of the enzymes necessary for hydrogen generation, hydrogenases, with the organism's catabolism. We want to circumvent that obstacle by isolating the required enzymes and combining them in novel, stable liposomes.

## Approach

The fast-growing cyanobacteria *Synechococcus elongatus* is cultivated autotrophically for the production of the photosynthetic subunits which are needed for the light induced water splitting. After isolation and purification of photosystem II, which catalyzes the oxidation of water, these light sensitive photo-enzymes are encapsulated together with hydrogenases into liposomes.

## References

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