Initial training into the basic principles of vanadium redox-flow batteries and methane-producing bioelectrochemical systems

In this advanced module at the *Fraunhofer UMSICHT*, Oberhausen the participating PhD students are given a closer insight into the technology of redox-flow batteries as well as bioelectrochemical systems:

Vanadium redox-flow batteries:

The integration of fluctuating renewable energies like wind and solar is a huge challenge of the future. Big battery systems based on redox flow technology offer many advantages. They enable longer storage times and higher capacities because power and capacity can be independently scaled up. *Fraunhofer UMSICHT* operates one of the largest test laboratories for redox-flow batteries in Europe with a test environment for independent function and power examination. This gives the opportunity to reproducibly compare different electrolytes or stacks with the aim to further improve the capability of this battery system. Different electrolytes can be examined simultaneously for their power capacities by, for example, adjusting the temperature levels (between 15 °C and 40 °C). Furthermore, big stacks as well as single cells can be built up and tested in a freely selectable environment, with testable stack sizes of up to 1 m^3 and weights of up to 1 t. In our test environment it is possible to apply a bidirectional power of 80 kW. The maximum measureable voltage is 100 V with a maximum current of 900 A.

Electromethanogenesis in bioelectrochemical systems:

Bioelectrochemical systems offer the possibilty to produce either energy or renewable products by using microbial metabolism. *Fraunhofer UMSICHT* just started with this interesting research area and at the moment lays its focus on the field of electromethanogenesis. This is due to the fact that a huge part of the world's energy supply is covered by the use of natural gas. Currently, the only renewable alternative to natural gas of fossil origin is to produce natural gas in bioplants through fermentation of organic waste and crops. The required resources to produce the biomass needed for this alternative are scarce because these resources are also indispensable for food production. Therefore, the aim of this project is to produce the needed amount of renewable natural gas without being dependent on biomass through the development, design and construction of a methane-producing microbial electrolysis cell (MEC). The use of this technology is one opportunity to achieve the goal mentioned above, since it is based on the bio-electrochemical conversion of carbon dioxide and electrical energy into methane. The research methods (e.g. cyclovoltammetry) are reproducible and can be done in a freely selectable environment at lab-scale.