CONVERSION OF LIGHT TO TRANSPORT FUELS THROUGH INTEGRATED OPTOELECTRONIC CELL FACTORIES

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Sunlight is a widely available source of energy, inherently bound to daily and seasonal cycles. In Finland, solar power is excessively abundant in summer when the need for energy is low and scarce during winter when the demand for energy is high. This seasonal variation highlights the need to establish efficient ways to store solar energy. Although many organic compounds could enable high energy storage density, current industrial methods to reduce CO_2 into fuels are not efficient enough to turn sustainably produced carbon-based fuels into economically viable forms of energy storage.

A collaboration between Aalto University and VTT Technical Research Centre of Finland, the Optobio project aims to increase the efficiency of CO_2 conversion to specific fuel components by developing integrated nonbiological-biological hybrid systems. During the project, new types of bioreactors are designed that utilize light and electricity in the conversion of CO_2 to transport fuels. We combine optoelectronic materials for UV and visible light absorption with microbial catalysts for bioconversion, enabling efficient bioconversion of solar energy into a storable form.

We anticipate major improvements in efficiency compared to other biofuel production technologies due to i) net utilization of a broad spectrum of sunlight, ii) enhanced energy uptake through additional energy transfer routes, iii) complementary production of reduced carbon sources through photochemical CO_2 reduction, and iv) protection of microbes from harmful UV wavelengths. Furthermore, the concept can also be used to produce other products, such as bioplastic precursors or platform chemicals, from CO_2 through microbial biochemistry.