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Using novel methods (microwave and sonochemistry) for converting biomass to biofuels

Aharon Gedanken

BINA - Bar-Ilan University, Israel

The lecture will present the use of novel methods such as microwave radiation and sonochemistry in converting Biomass into Biofuels. The lecture will demonstrate the direct conversion of as-harvested *Nannochloropsis* algae into bio-diesel without separating the lipidic phase. The results are based on the use of two novel techniques. The first being biotechnology-based environmental system utilizing flue gas from coal burning power stations for microalgae cultivation. This method reduces considerably the cost of algae production. The second technique is the direct transesterification (a one-stage method) of the *Nannochloropsis* biomass to biodiesel production using microwave and ultrasound radiation with the aid of a SrO catalyst. In the early stages of this research the lipidic phase was first extracted from the microalgae and transesterification followed it. Later we became courageous and carried out the transesterification directly on the as-harvested microalgae. Full conversion to biodiesel was achieved in 5 minutes. The combination of SrO solid catalyst and microwave radiation leads to full conversion (~100%) of the microalgae to biodiesel. The results are based on 1H NMR spectroscopy and HPLC results. Author will show how agricultural wastes such as pinecones, *Cicer arietinum*, cotton, and sugar cane bagasse are converted to a fine chemical such as levulinic acid in addition to conversion to ethanol. In addition, we have successfully converted a macroalgae, *Ulva rigida*, into bioethanol getting 16% ethanol from 1 gram of the algae. These results were obtained by optimizing the production of *Ulva rigida* co-cultured with fed-fish in an offshore mariculture (fish cages) system is reported. Enhanced production of biomass with elevated content of desired carbohydrates is achieved. This SSF (simultaneous saccharification fermentation) process was accomplished with the help of soft sonication. Finally, author will demonstrate a solar system in which a macroalgae solution is flowing on a catalyst and is being fermented by to ethanol aided by the solar irradiation. This reaction was conducted in a solar reactor that was designed to perform the conversion of starch, glucose, and Ulva rigida to ethanol in a single step. The role of the solar energy is 1) activating the catalysts 2) evaporating the ethanol produced in the process. A continuous flow through the apparatus was continued for more than 30 days. The instrument is presented in figure 1 below.

aharon.gedanken@biu.ac.il