Trends in Green chem, 3:2
DOI: 10.21767/2471-9889-C1-003

Development in biological conversion process of carbon dioxide from industrial flue gas to microalgae biomass

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Biological conversion of CO_2 using microalgae can be a sustainable solution to address global warming and energy crisis caused by fossil fuels. Microalgae have attracted considerable attention due to their ability for production of biofuels and useful chemicals by photosynthesis, and it is promising agent for biological CCU (carbon capture and utilization) technology. We developed two-track approach for effective microalgal CCU technology; first one is development in various micro-scale screening technology using microfluidic devices to select highly productive strain. Second one is development in mass culture system directly using the industrial flue gases. Flue gas containing 3–5% CO_2 from the combustion of LNG (liquefied natural gas) in CHP (combined heat and power) plants was supplied as carbon-feedstock to produce microalgae biomass. In the present system, natural solar radiation and hot water that has been heated without consuming any electric power were also used to improve the economic feasibility of CO_2 capture from the flue gas using microalgae. Also, blower was continuously operated from the stack of power plant to microalgae cultivation site to supply the flue gas. In addition, we developed a low-cost thin-film photobioreactor (PBR) system with a vertical bubble column, which can provide a viable option for direct capture and utilization of concentrated CO_2 emitted from power plants due to usability of scale-up and efficient capture of CO_2. Demonstration of biological CCU process was improved by integrating these technologies.

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SpecSoil: The newest innovative green technology for soil analysis

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A new methodology for soil analysis fertility based on the use of vibrational spectroscopy and Chemometrics has been developed and validated. This methodology employs Near Infrared Spectroscopy (NIRS) and multivariate calibration for the quantification of several soil fertility attributes such as Soil Organic Matter (SOM), silt, clay and sand. Current methods for evaluating these parameters are still based on wet chemistry methods which are time consuming and also generate residues that require additional treatment to be disposed of in nature. Due to the growth of precise agriculture there is a huge demand for analytical methods that can provide simple, fast, environmentally friendly and precise diagnosis for soil fertility. The growing interest in NIRS technology can be justified by the numerous and remarkable benefits that NIRS spectroscopy offers over conventional analysis: (i) it is a non-destructive technique, (ii) it is free from undesirable residues and thus has minimal environmental impact, (iii) it is a low-cost technique and (iv) it is a rapid and innovative technique that requires little sample handling when combined with Chemometrics. In this lecture, the methodology which is based on a huge spectral and analytical soil data bank representative of the Brazilian territory will be presented.

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