IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Interactive Presentations - IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (IP)

Author: Mr. Vaclav Havlicek
TRL Space, Czech Republic

MICROALGAE CULTIVATION FACILITY WITH INTEGRATED RAMAN SPECTROSCOPY: A PATH TOWARDS OPTIMIZED BIOPRODUCTION IN MICROGRAVITY

Abstract

This paper introduces a facility designed specifically for cultivating microalgae in microgravity environments. The system integrates a novel feature – a built-in Raman spectrometer – enabling direct, real-time analysis of samples within the bioreactor. This innovation fosters several significant advancements:

Enhanced Autonomy and Remote Operation: In combination with build-in control unit allowing remote operations, the integrated Raman spectrometer empowers the bioreactor to function as a self-contained device, eliminating the need for astronaut intervention during sample analysis. This translates to increased operational efficiency and reduced reliance on human involvement, particularly crucial in remote space settings.

Expedited Cultivation Optimization: The ability to conduct real-time analysis using the Raman spectrometer paves the way for faster optimization of the cultivation cycle. By continuously monitoring the bioreactor's internal environment and the microalgae's response to various conditions, researchers can swiftly identify and implement adjustments necessary to achieve optimal growth and biomass production.

Tailored Biomass Production: The precise control facilitated by the Raman spectrometer empowers researchers to fine-tune the cultivation process and achieve targeted biomass production within a desired timeframe. This enables the facility to cater to diverse applications, generating microalgae biomass suited for various purposes based on mission-specific requirements.

Stepping Stone Towards Space-Based Applications: The integration of Raman spectroscopy signifies a crucial step towards translating microalgae research into practical applications within space stations. By enabling a deeper understanding of the cultivation needs and the potential of microalgae biomass in this unique environment, the facility paves the way for:

Life Support Systems: Microalgae can serve as a source of oxygen, food, and water for astronauts on extended space missions. Space-Based Agriculture and Nutrition: Cultivated microalgae can provide essential nutrients and contribute to the development of sustainable food production systems in space. On-Demand Production of Biomolecules: The facility holds potential for the production of valuable biomolecules, such as drugs and other chemicals, directly within the space station, eliminating reliance on Earth-based supplies. The development of this innovative facility marks a significant leap forward in microalgae research for space applications. By enabling self-sufficient operation, optimized cultivation, and targeted biomass production, this technology paves the way for a future where microalgae play a vital role in sustaining human life and endeavors in space.