Combination of tunable diode laser absorption spectroscopy and isothermal microcalorimetry for life sciences.

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Abstract:

Isothermal microcalorimetry (IMC) is a very sensitive technique to assess microorganisms metabolism and monitor their growth when even at low concentration. Isothermal microcalorimetry provides real-time insights on the metabolic activity or microbes and is very useful to assess shift in metabolism for example. However due to the label-free nature of the measurement performed mostly using sealed vials (except for flow-through instruments), it is sometime difficult to get additional insights.

In this context tunable diode laser absorption spectroscopy (TDLAS) is a valuable addition to the conventional IMC measurement as it allows to monitor the headspace concentration of gases in the calorimetry vials. In our recent laboratory work we have investigated the the two technologies separately to perform sterility assessment of pharmaceutical products. In addition, we used these techniques in combination to perform calorespirometric analyses on liquid culture and biofilms grown on nylon membranes.

Our work indicate that metabolism can be investigated accurately using the two methodologies in parallel to combine metabolic heat production data with oxygen consumption and carbon dioxide production data. In addition, it appears that combining the 2 methods is valuable as less work is needed compared to the conventional use of the NaOH or chromogenic CO_2 traps. For biofilms and liquid cultures gas measurement and metabolic heat measurments fitted with each other and with the biology of the investigated microorganisms.