Gas Analysis
Application Note 301

Real Time Analysis of Multiple Compounds in Human Breath

Breath by Breath Analysis of Expired VOCs during Exercise

Summary

VOCs in Human Breath
The use of VOCs as a real-time marker in human breath for physiological events such as lactate threshold, and oxidative stress is a challenge for conventional 'off-line' gas analysis equipment, such as GCMS. The analysis necessitates very fast response, coupled with a wide dynamic range. Monitoring breath VOCs could be an effective non-invasive tool to investigate physiological events in real-time.

The HPR-20 Transient MS is ideal for this application due to the fast response, wide dynamic range and high sensitivity offered by the PIC detector. This allowed the compounds to be measured 'breath-by-breath', a significant improvement over traditional 'off-line' techniques. Additional dynamic factors such as changes in breathing rate and end-tidal could be deduced.

Figure 1: The Hiden HPR-20 Transient MS

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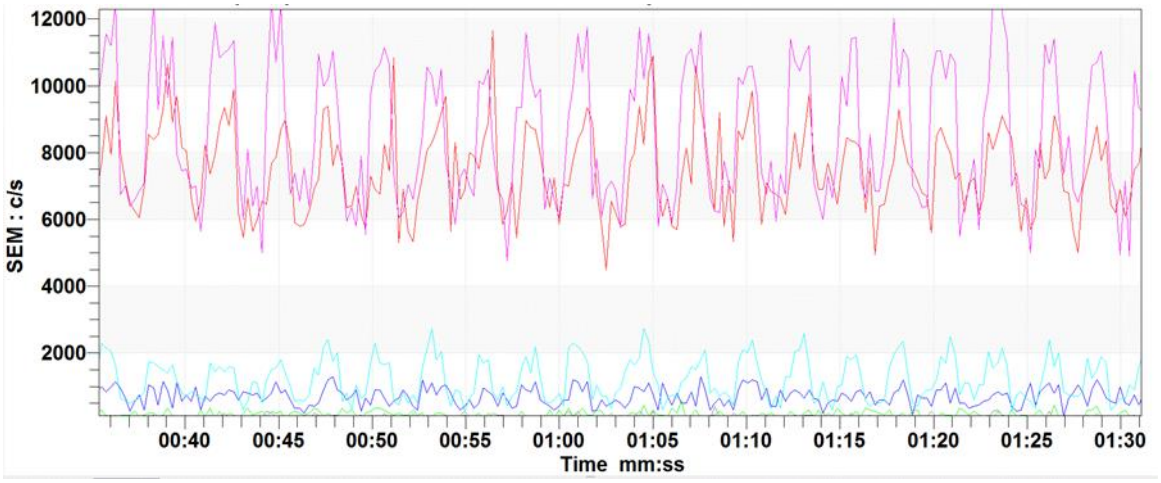

Figure 2: Example data showing the real-time analysis of muliple compounds exhaled in human breath during an exercise test.

Experimental Setup

The HPR-20 QIC TMS was connected to a proprietary breathing mask via a customized adaptor, optimized for high speed analysis. Subjects of varying ages and fitness levels were set a maximal exercise test on a stationary bicycle with breath monitored in real-time. The test consisted of a common physiological test called a 'ramp test', which aims to exercise the subject to their aerobic capacity.

Results

Data obtained from the experiments allowed the real-time tracking of multiple compounds produced in varying amounts during aerobic and anaerobic respiration. The time resolution (20 ms per data point) allowed the concentration of compounds in each breath to be monitored. Inflections were seen in the data at points that could be related to physiological changes in the subject, such as lactate threshold. Monitoring changes in VOC compounds during physiological events is novel and not easily seen with other techniques. Figure 2 shows an example of the fast response of the HPR-20 QIC Transient MS allowing for each breath to be viewed. In contrast to traditional off-line techniques, parameters such as end tidal as well as breathing rate can be readily deduced.

Conclusion

- The Hiden HPR-20 QIC TMS is shown to be the ideal product for high speed, high sensitivity analysis of compounds in human breath.
- Real time analysis of exhaled species is a novel research tool.
- The excellent response time and dynamic range offered by the HPR-20 allow the concentration changes of multiple compounds to be measured in real time