A new approach for monitoring sweat NH_3 levels using a ventilated capsule

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Sweat NH_3 as a biomarker?

Monitoring sweat [NH_3] shows opportunities to non-invasively monitor our health.

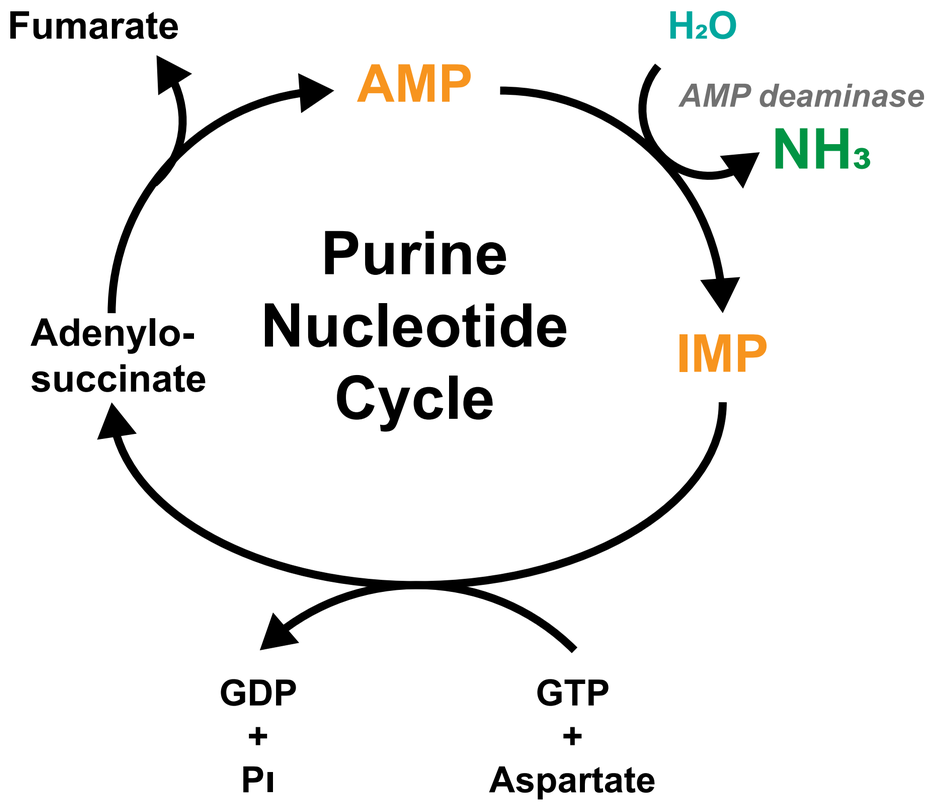
1. Monitoring muscle fatigue

Lactate in sweat is not related to blood lactate levels.

Can we use sweat [NH_3] as an alternative?

2. Clinical applications: diagnostics

Metabolic myopathies such as MAD deficiency show very low blood [NH_3] during ischemic exercise.



Real-time Sweat NH_3 measurement

To research the potential of using NH_3 as a biomarker a new sweat measurement system is developed.

absorbent patch technique

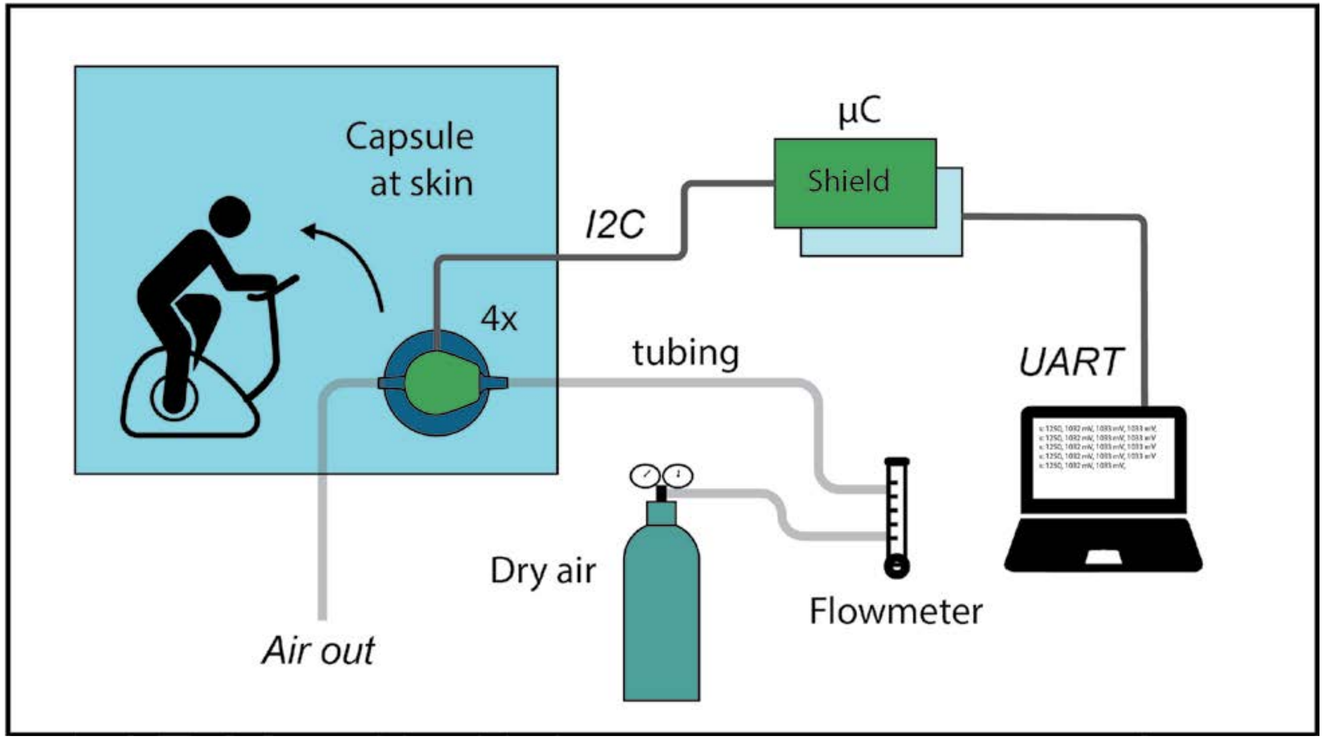
Challenges with current methods:

- Risk of skin contamination
- Bacteria influence composition: immediate analysis required
- NH_3 quickly evaporates

The ventilated capsule technique

A new approach:
Measuring NH_3 that is evaporated from sweat with a metal oxide gas sensor.

Dry air flows (0.2 to 1.2 l/min) through a capsule with an NH_3 sensor ⟶
the flow is measured with a rotameter.

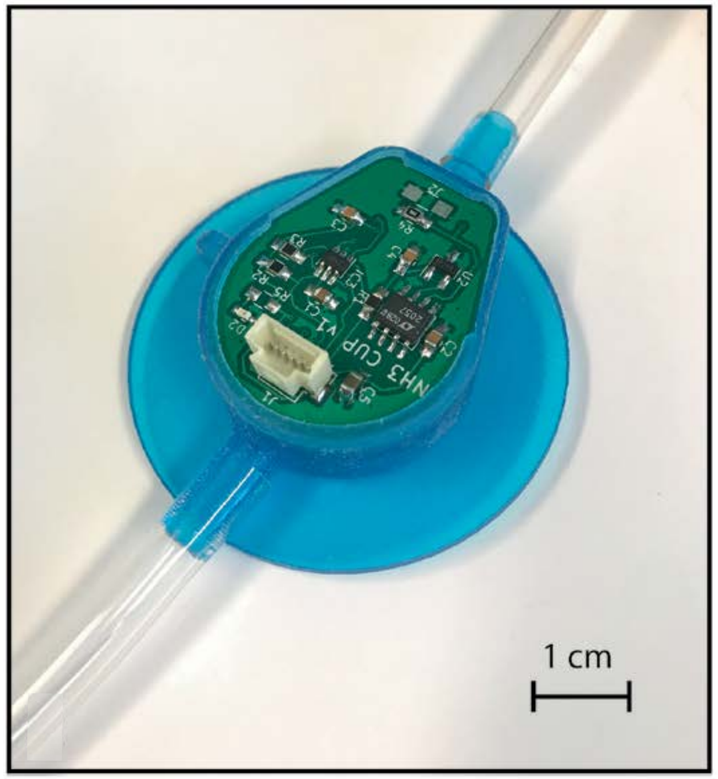


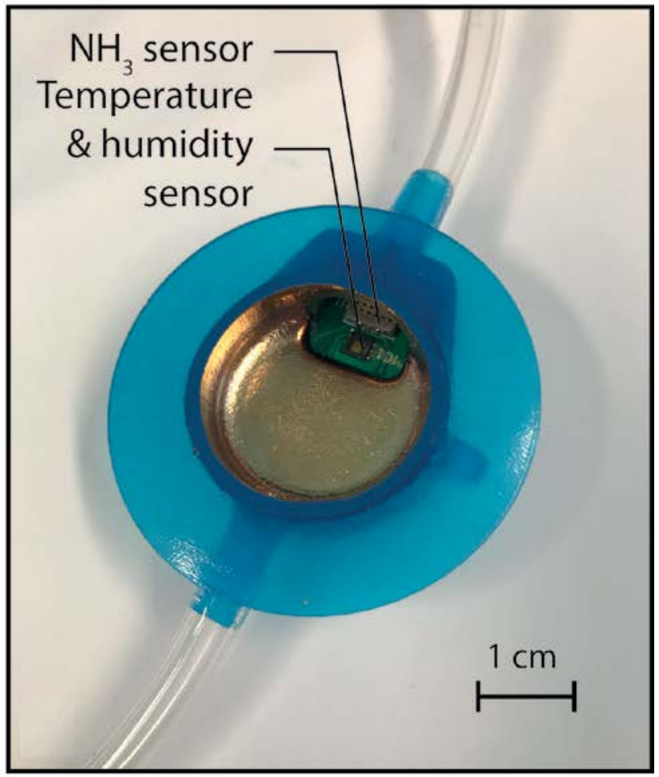
The Capsule

- The MICS-5914 sensor is placed in the capsule and measures the evaporated [NH_3].

- A humidity sensor and temperature sensor are integrated as well.

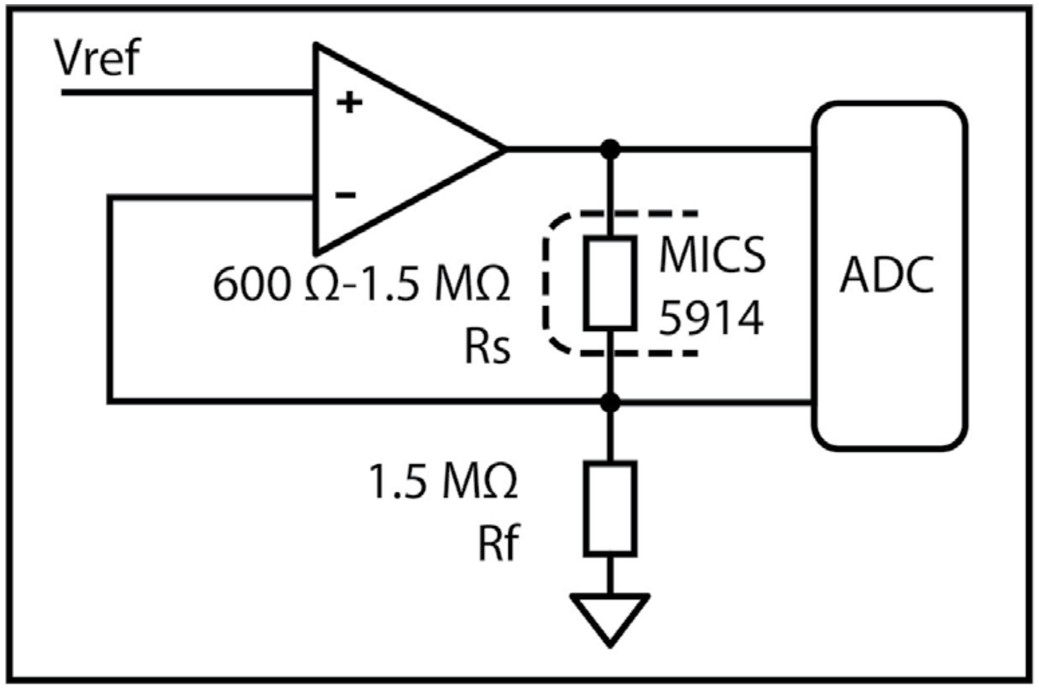
- A gold layer is sputtered at the inside, to prevent absorption of NH_3



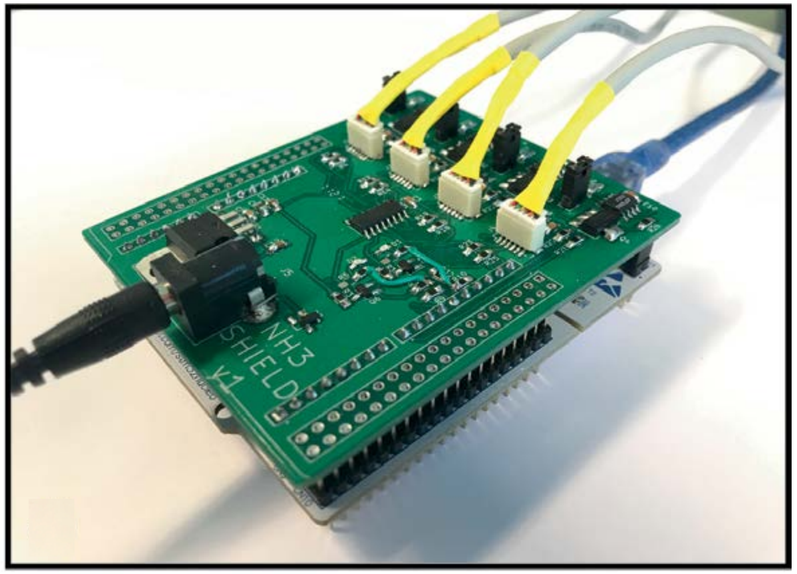


Electronics

Read-out: A series-series feedback circuit at the **capsule pcb.**



Current source for the sensors' heater circuit, microcontroller, and multiplexer (switching between 4 capsules) at the **'shield'.**

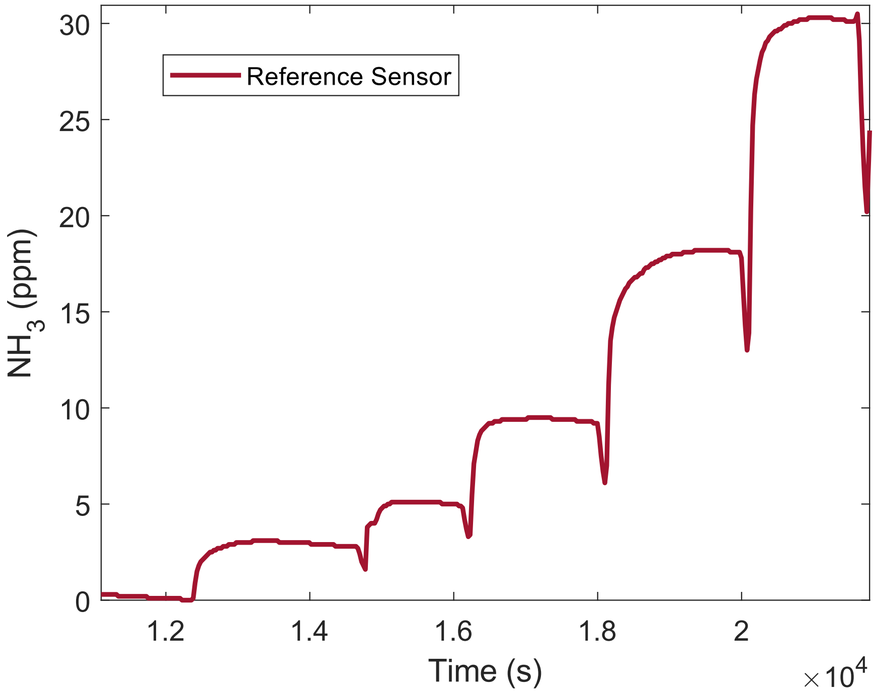


Sensor Characterization

- To calibrate the MICS-5914 sensors, an electrochemical reference sensor was used (S900 Aeroqual, New-Zealand).

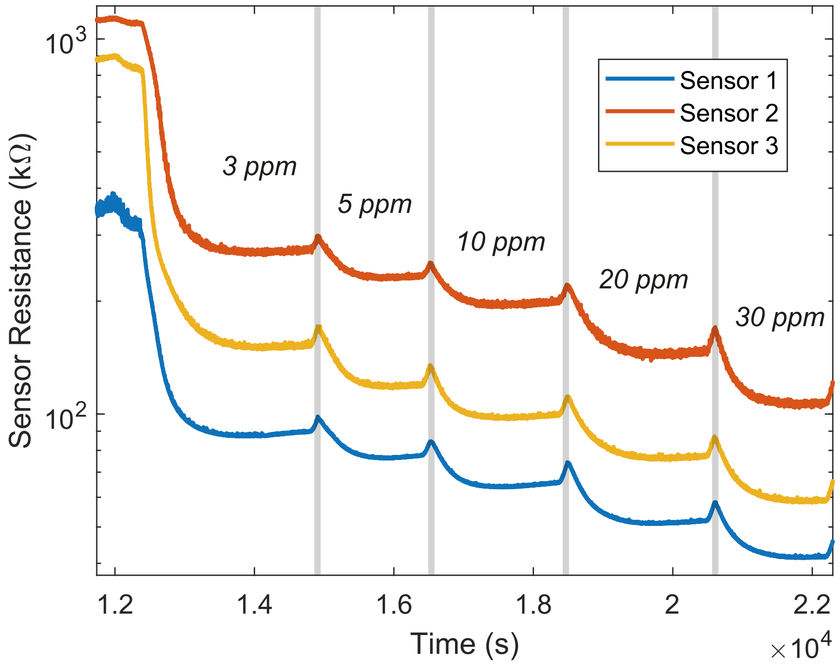
- An environment with different concentrations of NH_3 was created (3-30 ppm).

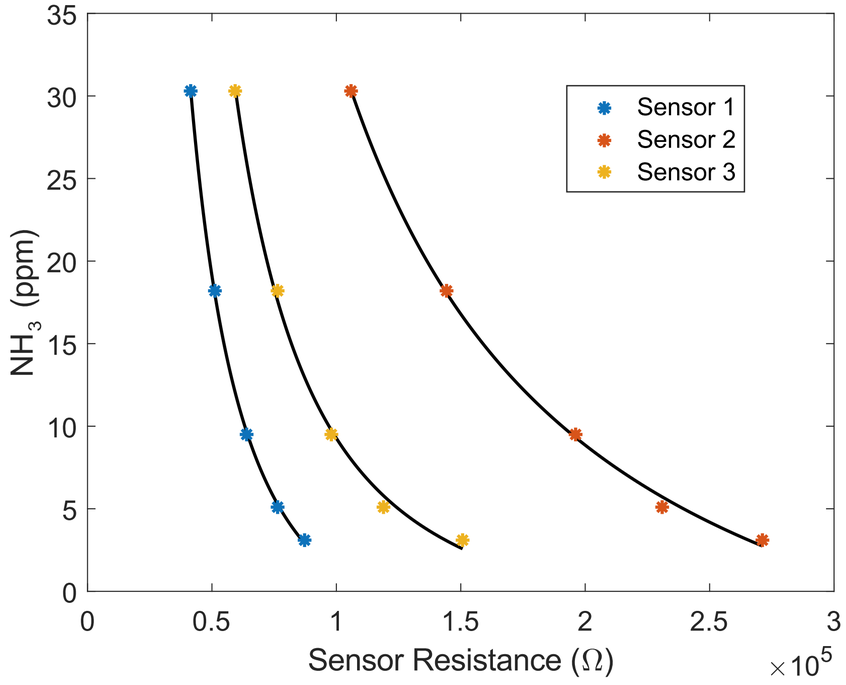
- Temperature: 25 °C, and humidity level: 60%.



Sensor Characterization

- The sensors show good sensitivity from 27 mV/ppm to 1.1 mV/ppm in the desired measurement range of 1 to 30 ppm.





Humidity effects

When exposed to a changing humidity level (from 38% to 50%), a clear drop in sensor resistance is seen.

⟶ similar to literature (Krivec et al. 2015, *Sensors*)

This emphasizes the importance of integrating the humidity sensor in the capsule.

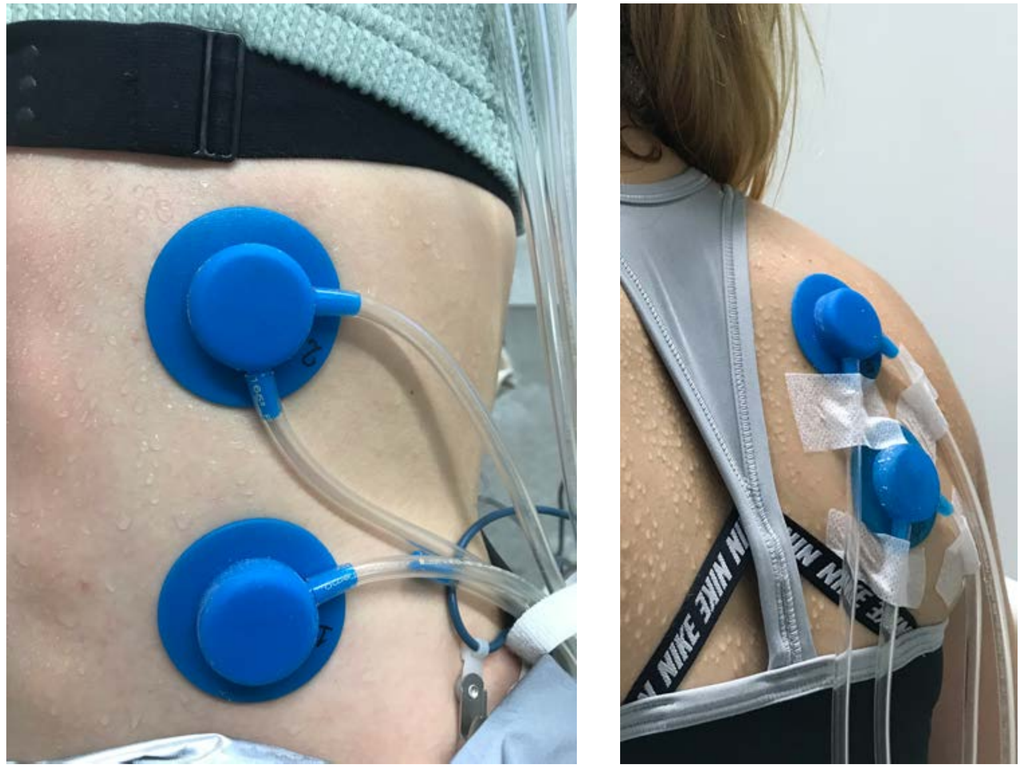
Future steps include calibrating the sensors at different humidity and temperature levels to compensate for these influences.

Future Research

The new NH_3 measurement system will be tested in a physiological experiment (incremental cycling exercise).

- Calculate sweat rate from humidity measurements & air flow rates.
- Calculate concentration of NH_3 in sweat.

Previous experiments showed good reliability of the capsules (air tightness of the 3D printed photopolymer and adhesion to the skin).



Capsules tested in previous sweat rate experiments

Thank you for your attention

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