A Wearable Platform for Harvesting and Analysing Sweat Sodium Content

Ruairí Barrett[a] , Margaret McCaul[a] , Ursula Finnegan[a] , Paddy White[b] , Florin Stroiescu[b] , Gordon Wallace[c] and Dermot Diamond[a] .

Sodium Monitoring in Sweat

- **What can sodium levels indicate in individuals?**
  - Dehydration
  - Exercise associated hyponatremia (overhydration) in long distance athletes
  - Cystic fibrosis (Abnormal levels of 90-120 mM compared to the standard 10-70mM)[1]

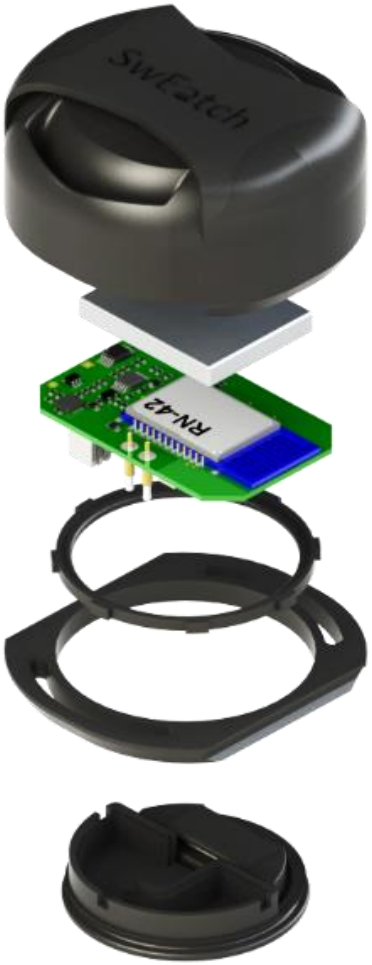
- **What can we do with this information?**
  - Protect athletes from overexertion/fatigue
  - Tailor/optimise hydration schedules in athletes
  - Monitor efficacy of cystic fibrosis treatments

https://www.theguardian.com/sport/2016/sep/19/alistair-brownlee-jonny-world-triathlon-series

http://*www.news.com.au/sport/commonwealth-games/commonwealth-games-officials-fire-back-over-marathon-controversy/news-story/373fe870303c3dcf254c9abd014ba166*

[1] *Ferner, S., et al. "[Reference values of Na (+) and Cl (-) concentrations in adult sweat]." Zeitschrift fur Erkrankungen der Atmungsorgane 175.2 (1989): 70-75.*

SwEatch – Device Overview

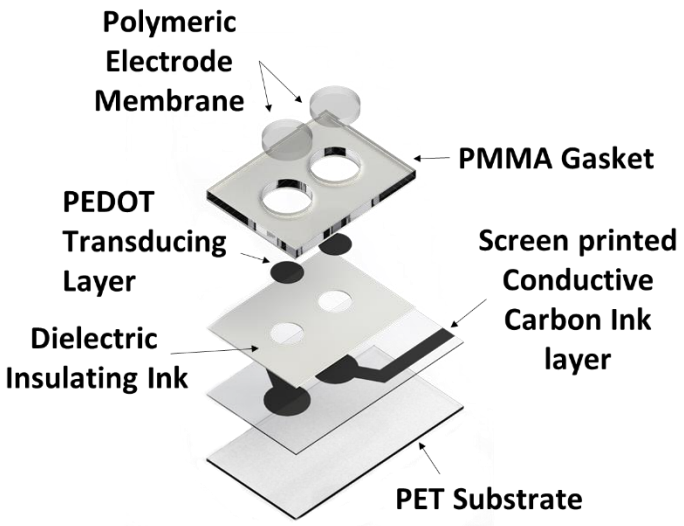


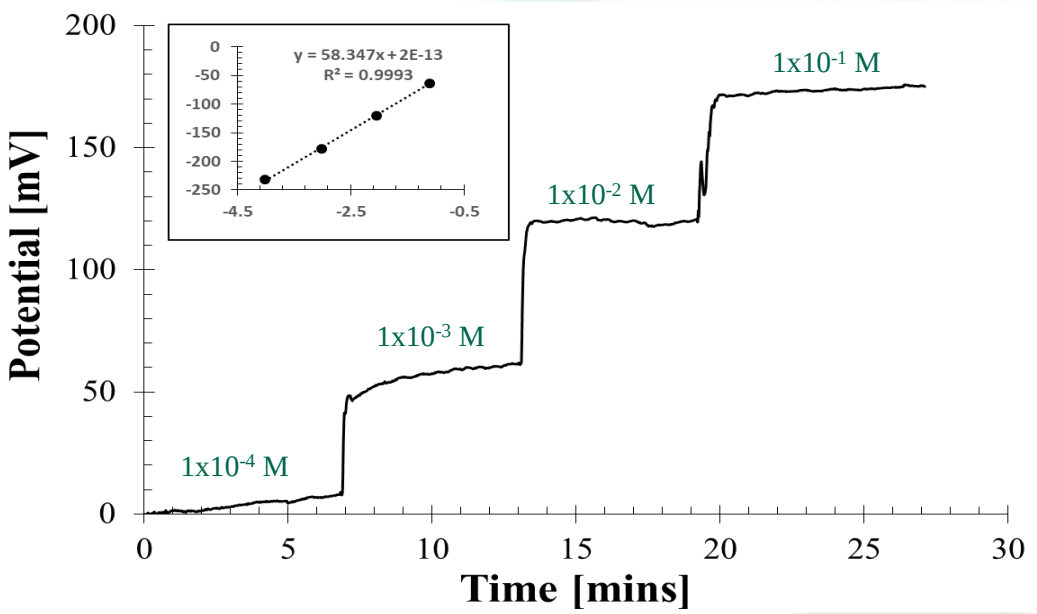
1
2
3
4
5
6

1. SwEatch Device Enclosure
2. Battery
3. Shimmer Electronics Board
4. Silicon holder for Sweat Reservoir
5. Bottom Part of Enclosure
6. Sweat Reservoir

Solid Contact Ion Selective Electrodes

- Low cost, highly sensitive, screen printed electrodes.
- Calibrated from 0.1 – 100 mM.
- The graph below shows the linear & Nernstian response between decadal intervals of NaCl solutions.



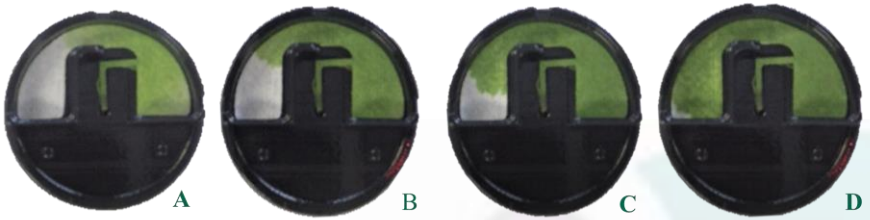


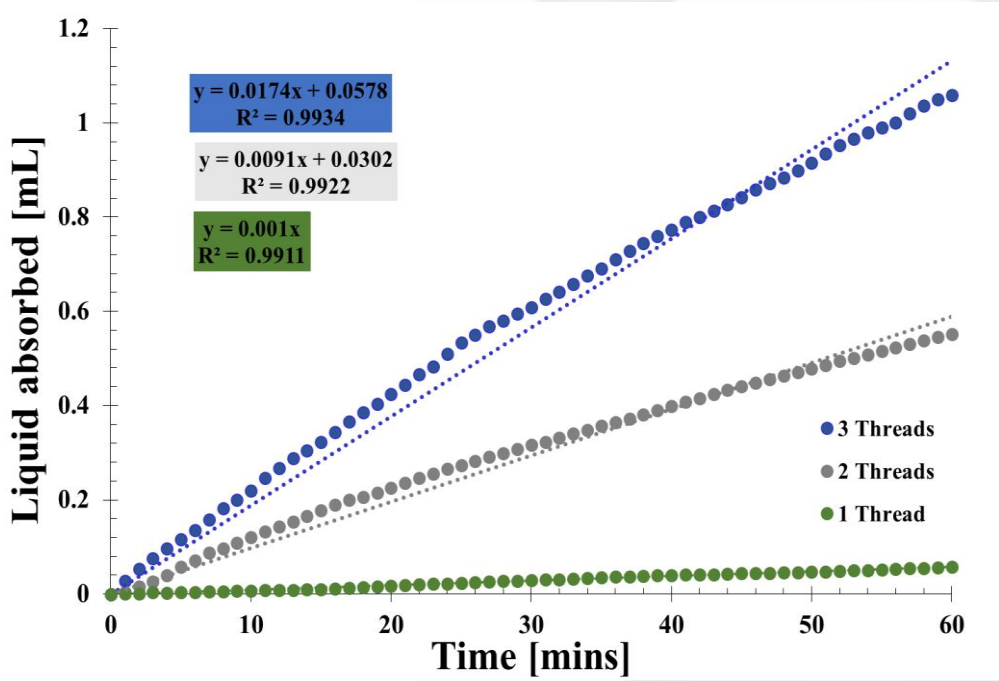
Sample Acquisition

- The ‘SwEatch’ platform combines a simple passive pumping approach

The flow rate is controlled by thread fluidics.

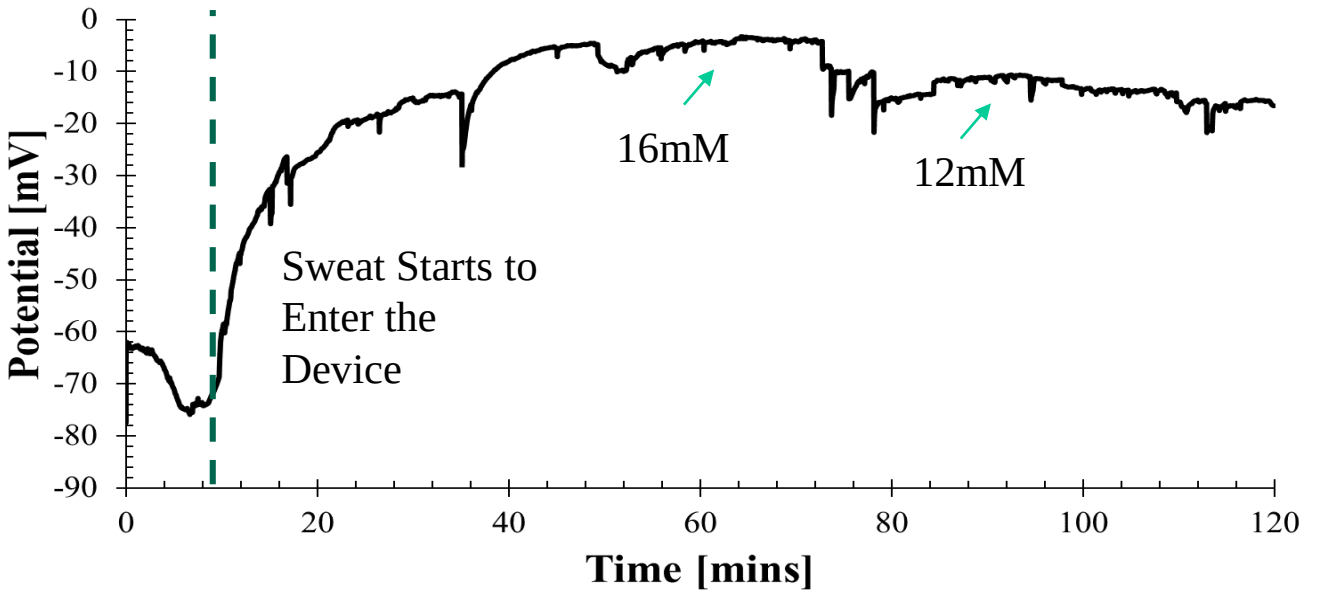
- 1 thread giving a flow rate of ~ 1 µL/min.
- 2 threads diving a flow rate of ~ 10 µL/min.
- 3 threads giving a flow rate of ~ 17 µL/min.





n=3

On-Body Trials



- During on body trials sweat is harvested from both the upper arm and wrist by using a pod and watch 'SwEatch' platform on a stationary bike over 120 minutes in this case.
- Initial Signal from priming device with a low concentration of NaCl.
- Signal spike observed circa 8 minutes when sweat started to enter the device.

Acknowledgements

Thanks to..
Supervisors Dr. Margaret McCaul & Prof. Dermot Diamond
Insight Centre for Data Analytics
Science Foundation Ireland
Enterprise Ireland
Shimmer
ARC Centre of Excellence for Electromaterials Science.

We gratefully acknowledge support from Enterprise Ireland (grant number IP-2016-0504) and Science Foundation Ireland through the INSIGHT Centre (FI/12/RC/2289). Support from the Australian Research Council ACES Centre at the University of Wollongong is also acknowledged.