# A Wearable Platform for Harvesting and Analysing Sweat Sodium Content

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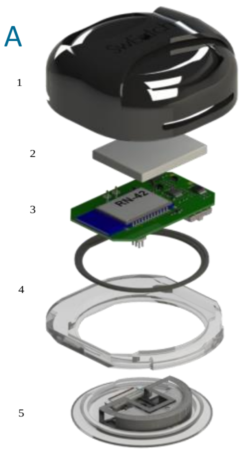
## Introduction

'SwEatch', the device in this poster, has the ability to monitor sweat sodium content of a wearer non-invasively in real time. It harvests and analyses sweat as it emerges from the skin. Sodium levels in sweat are of utmost importance in terms of monitoring hydration levels and also in the diagnosis of Cystic Fibrosis.

## Device Design/Fabrication

The outer enclosure of the device is custom designed and manufactured by a Stratasys Objet260 Connex1 3D Printer which utilises Polyjet technology. This technique allows for a much higher resolution of small feature and a much smoother finish than other 3D printing techniques. The sweat harvesting plate and reservoir is also manufactured using 3D printing methods, and is designed to provide constant contact with the skin to be able to harvest the sweat from the wearer. The 3D printed components are manufactured from a biocompatible material which allows the watch to be used without irritation.

A



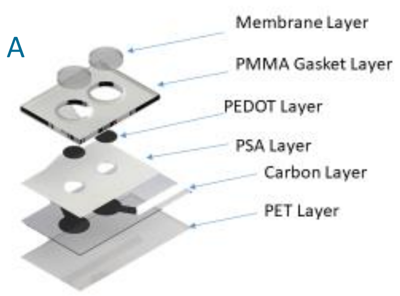

B C


Figure 1: A. Exploded view of the watch platform where 1. is the watch enclosure,2. battery 3. Shimmer electronics board, 4. bottom slider of enclosure which includes a silicon seal and 5. the sweat harvester plate and reservoir. B. Rendered image of the watch and strap. C. Image of the watch platform on body.

## Electrodes

The device employs low cost, highly sensitive, screen printed electrodes(SPE's), which utilise Na+ selective, solid-contact ion selective electrodes as well as a reference electrode to detect Na+ in the range of 0.1-100 mM. Below is an example of the different layers of the screen printed electrode and the order in which it is assembled/manufactured. Also shown is an example of a calibration of an electrode showing the linear response between the decades of concentration.

A

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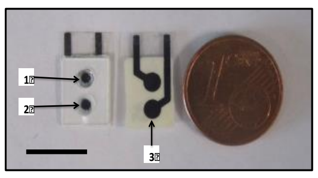



Figure 2: A. Exploded render of the screen printed electrode showing all of the layers. B. Front and back of electrode with coin for scale.

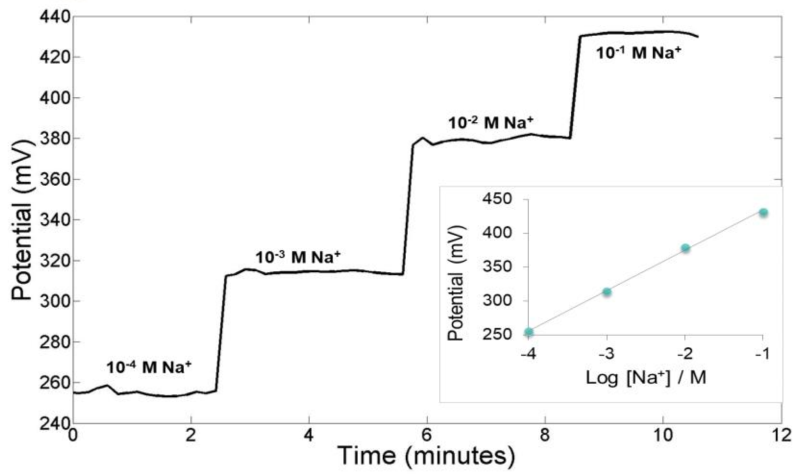
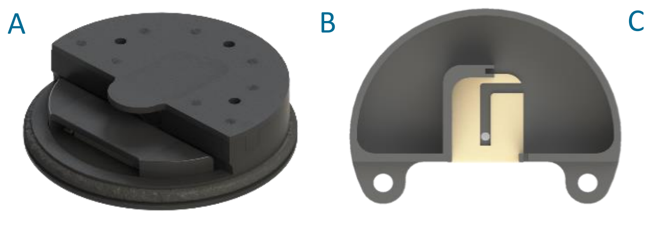



Figure 3: Calibration of a Na+-ISE and RE output signal using the Shimmer board, giving a slope of 56.98mV and an R2 value of 0.99.

## Fluidics

The sweat reservoir has been greatly improved over many generations. Again utilising 3D printing technologies variance between reservoirs has almost been eliminated, there are now two pieces in the assembly as opposed to the ten layers in the PMMA/PSA assembly. Below are the results obtained from varying the number of threads used to wick sweat into the reservoir.

A B



C

Figure 4: A. Rendered image of 3D printed reservoir + sweat harvesting plate. B. 3D printed reservoir highlighting the microfluidic channel. C. Image of an actual 3d printed reservoir including absorbent material to show the microfluidic channel

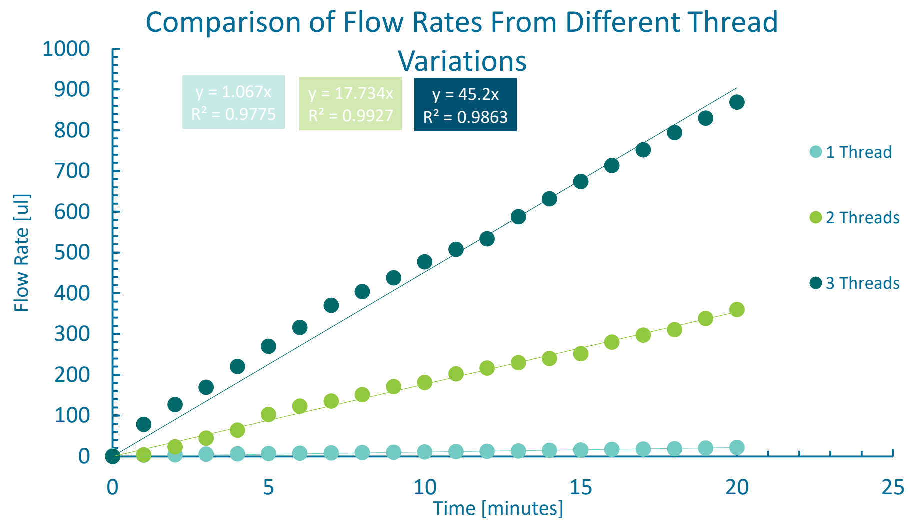



Figure 5: Flow rates obtained different threads using for wicking the liquid from a sampling well.

## Clinical Trials

**Subject 1**:
- **Sex:** Male
- **Age:** 26
- **Absolute $VO_{2\ Max}$** 4.2L/min
- **Relative $VO_{2\ Max}$** 50.8mL/kg/min

During on body trials sweat is harvested from both the upper arm and wrist by using a pod and watch 'SwEatch' platform . This was carried out on 7 subjects on a stationary bike over 60 minutes. Both platforms being primed with $10^{-4}$ M NaCl. Below is an example of the trial set up and the results seen from such a trial.

Figure 6: The watch and pod like 'SwEatch' platform placed on the volunteers wrist and upper arm during trials

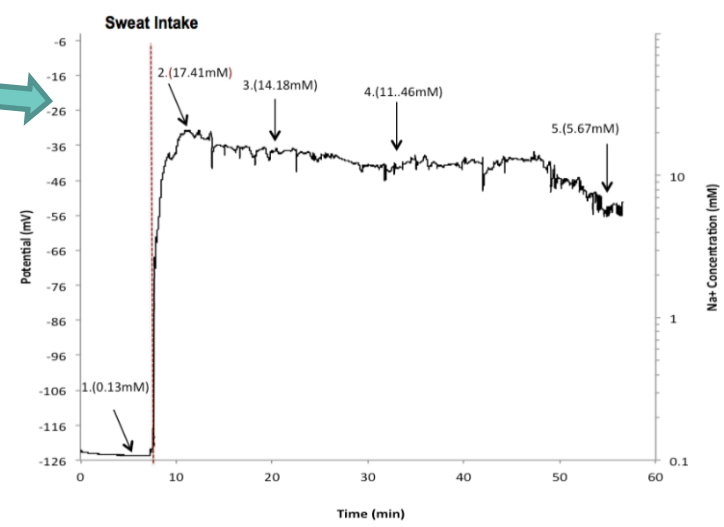



Figure 7: Real-time data received from the pod platform during on-body trials. Sweat intake occurs at about 7 minutes

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