



#### Contactless Conductivity Sensor for Wearable Sweat Monitoring

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# Background: Sweat as a diagnostic tool

Hydration

DC

• Disease (CF)



#### Health Problems with Cystic Fibrosis



#### https://en.wikipedia.org/wiki/Cystic\_fibrosis

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Sampling
Sample
Sample
Analysis
mechanism
handling



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S. M. Shirreffs and R. J. Maughan, Journal of Applied Physiology January 1, 1997 vol. 82 no. 1 336-34

DC

PharmChek Sweat collection patch. https://www.premierintegrity.com/Images/testing\_sweatpatch\_445 .jpg



### Temporary tattoos

- + Inexpensive
- + Unobtrusive
- + Disposable

DC

- Fully Wearable?
- Real time?



Jia, Wenzhao, et al. "Electrochemical tattoo biosensors for realtime noninvasive lactate monitoring in human perspiration." *Analytical chemistry*, (2013).



Perry, T. S. (2015, May 29). A Temporary Tattoo That Senses Through Your Skin. Retrieved July 19, 2015, from <u>http://spectrum.ieee.org/biomedical/devices/a-temporary-tattoo-that-senses-through-your-skin</u>

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#### Watches and Wristbands



+ Fully integrated device



- Use time?









Gao, Wei, et al. "Fully integrated wearable sensor arrays for multiplexed in situ perspiration analysis." Nature 529.7587 (2016): 509-514.



DCI



Glennon, Tom, et al. "'SWEATCH': A Wearable Platform for Harvesting and Analysing Sweat Sodium Content." Electroanalysis (2016).



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### Experimental set-up

- Capacitively coupled contactless conductivity (C<sup>4</sup>D)
- No biofouling of sensor



10mm x 6mm x 0.75mm

6











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Voltage vs. time using 10, 30, 60, 90 and 130 mM NaCl at a flow rate of 20µL/min. Each measurement was taken in triplicate 5 min tests and averaged. A PDMS microchannel with a surface area over the electrodes of 0.183 mm<sup>2</sup> was used.

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## Maximize surface area of the channel with respect to the electrode







#### PMMA channel design







### Injection of varying NaCl concentrations



Au microelectrode voltage vs. time graph using 10 mM NaCl as the eluent and injecting  $100\mu$ L of (A)130 mM NaCl and (B) 30, 60, 90 and 130 mM NaCl at a flow rate of  $20\mu$ L/min. A PMMA microchannel with a surface area over the electrodes of 0.36 mm<sup>2</sup> was used.

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- New PMMA channel designs
  - Minimizing fluidic volume
  - Maximizing surface area

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- Varying flow rates
- Integration into onbody platform

DC



Glennon, T; O'Quigley, C; McCaul, M; Coyle, S.; Matzeu, G; and Coleman, S; and Ben Azouz, A; Beirne, S; Wallace, G; and White, P; O'Mahoney, N; Diamond, D. (2016) *'SWEATCH'* - *A platform for real-time monitoring of sweat electrolyte composition*. In: ACES2016 Symposium, 10-12 Feb. 2016, Deakin Jniversity, Melbourne, Australia.



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