

LOW IMPEDANCE, LOW COST ELECTRODES FOR LONG-TERM ELECTROENCEPHALOGRAPHY AND NON-INVASIVE ELECTRICAL BRAIN STIMULATION.

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ABSTRACT

Here we present electrodes that can be used for both EEG recording and prolonged electrical stimulation.

The electrodes consist of saline-soaked foam and a sheet of conductive silicon.

The impedance of the electrodes was measured and quality of EEG recordings was compared against dry electrodes.

INTRODUCTION

- At BrainPatch we are working towards making closed-loop neural stimulation devices and protocols accessible to everyone (also see poster 797.11, DP15/DD39).

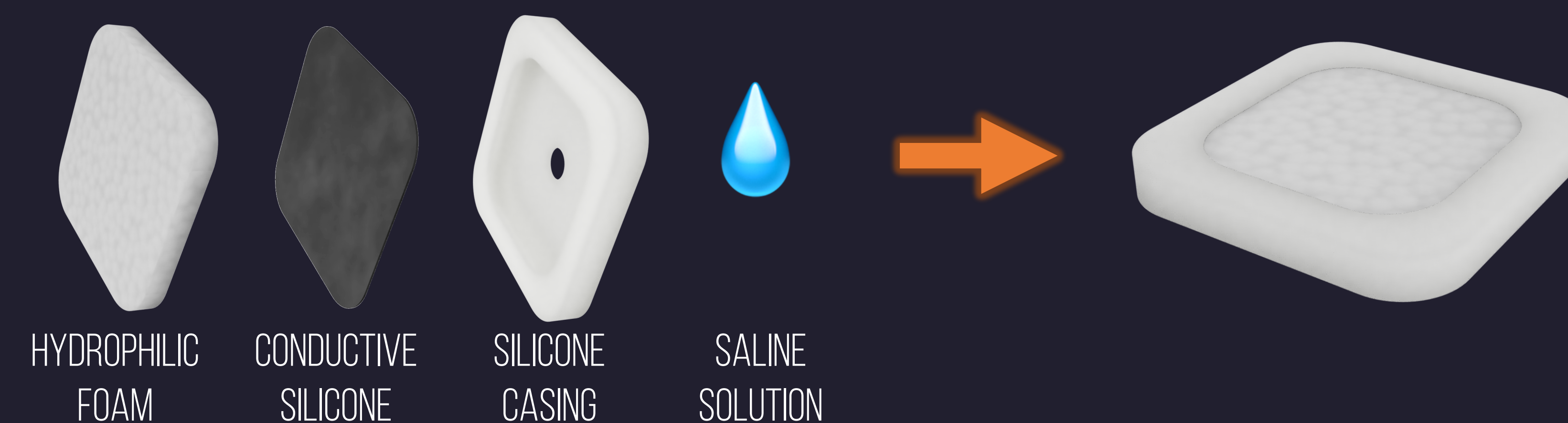
- We needed electrodes that enable simultaneous EEG recording and tES stimulation that are convenient and low cost.

- Current electrodes suitable for EEG and NIBS require cumbersome procedures of gel¹ or special paste application prior to the electrode set up; saline-soaked sponges may also be used but their EEG performance may be inconsistent.

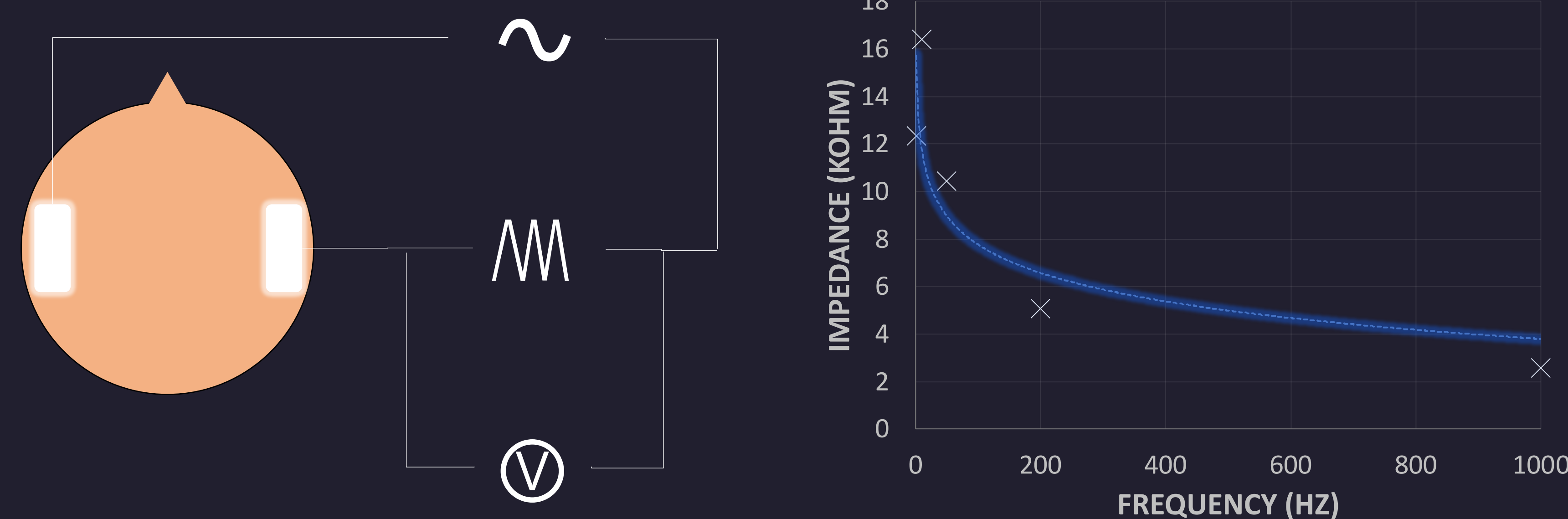
- Semi-dry tES electrodes² are limited to areas with no hair.

- Consumer-grade commercially available electrodes (foc.us) have not been tested for EEG applications to our knowledge.

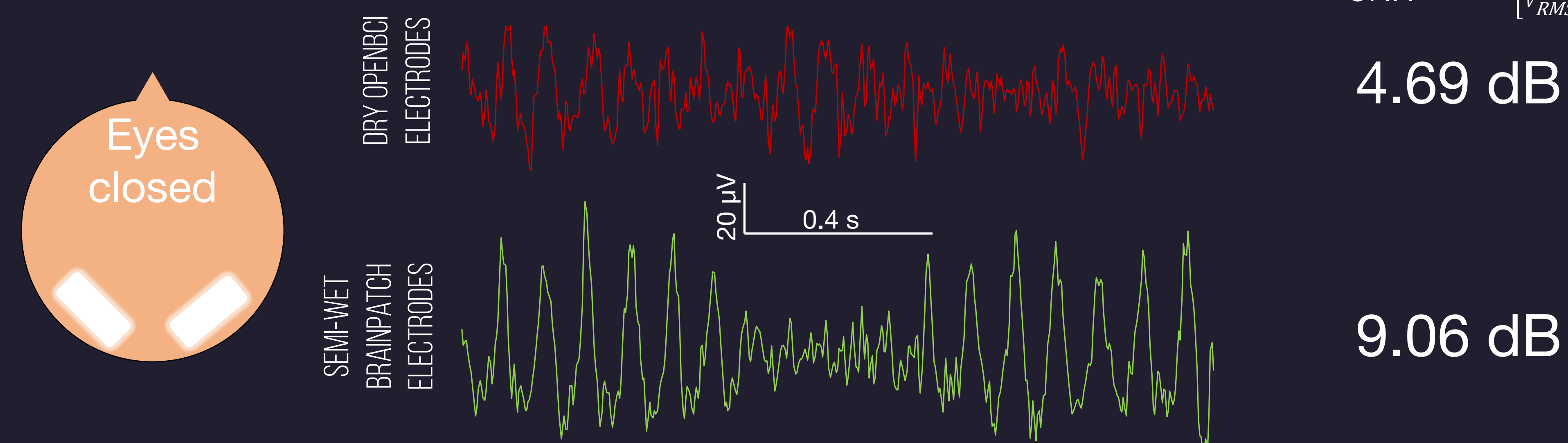
SEM-DRY ELECTRODE ASSEMBLY



IMPEDANCE TEST



EEG RECORDING DRY VS SEMI-DRY ELECTRODES



CONCLUSION

- The low cost of components and the ability to re-use the electrodes justifies the expense for making or purchasing.
- The electrodes do not require gel or paste application and do not leave a trace on the hair other than a slightly wet area that dries quickly
- Low impedance and ionic interface means it could be used for non-invasive brain stimulation (tDCS, tACS, tCS)
- The electrode casing provides stability for long term recording (not shown, see image in abstract)
- The SNR of EEG recording is improved compared to dry EEG electrodes
- Please contact us directly via e-mail at info@brainpatch.ai or register your interest at the DP15/DD39 poster.

DISCUSSION

- There is potential for a system that can switch between the recording and stimulation or even perform the two procedures simultaneously.
- This will ultimately lead to the development of personalized closed-loop electrical stimulation protocols.

REFERENCES

1. Electrodes for high-definition transcutaneous DC stimulation for applications in drug delivery and electrotherapy, including tDCS. Preet Minhas, Varun Bansal et al. *Journal of Neuroscience Methods*, Volume 190, Issue 2, 2010, 188-197.
2. Dry tDCS: Tolerability of a novel multilayer hydrogel composite non-adhesive electrode for transcranial direct current stimulation. Khadka, Niranjana et al. *Brain Stimulation: Basic, Translational, and Clinical Research in Neuromodulation*, Volume 11, Issue 5, 2017, 1044 – 1053