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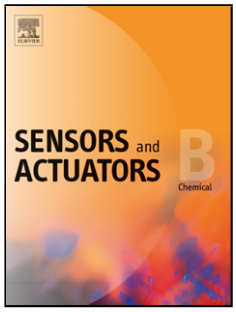

Title: A Microneedle electrode ARRAY ON FLEXIBLE SUBSTRATE for long-term EEG monitoring

Author: <ce:author id="aut0005" biographyid="vt0005" author-id="S092540051730059X-057b180880b5955d4875858a1454ea15"> Renxin Wang<ce:author id="aut0010" biographyid="vt0010" author-id="S092540051730059X-ba79993b1809780582edc5072f1184f0"> Xiaoming Jiang<ce:author id="aut0015" biographyid="vt0015" author-id="S092540051730059X-344918f813a6d27170094e691af1bf4f"> Wei Wang<ce:author id="aut0020" biographyid="vt0020" author-id="S092540051730059X-e391f41badd5d4cac869e75f7765f4a6"> Zhihong Li

PII: S0925-4005(17)30059-X
DOI: http://dx.doi.org/doi:10.1016/j.snb.2017.01.052
Reference: SNB 21577

To appear in: *Sensors and Actuators B*

Received date: 9-8-2016
Revised date: 20-11-2016
Accepted date: 6-1-2017

Please cite this article as: Renxin Wang, Xiaoming Jiang, Wei Wang, Zhihong Li, A Microneedle electrode ARRAY ON FLEXIBLE SUBSTRATE for long-term EEG monitoring, Sensors and Actuators B: Chemical http://dx.doi.org/10.1016/j.snb.2017.01.052

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ACCEPTED MANUSCRIPT

A MICRONEEDLE ELECTRODE ARRAY ON FLEXIBLE SUBSTRATE FOR LONG-TERM EEG MONITORING

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Highlights

- A flexible parylene-based microneedle electrode array (P-MNEA) is developed.
- Competitive impedance density of 7.5 KΩ*cm^2@10Hz is attained.
- Prominent stability in long-term impedance is illustrated.
- Flexibility of P-MNEA contributes to recording baseline stability.
- P-MNEA realizes credible EEG acquisition.

Abstract—**Conventional wet electrodes require skin preparation and gel usage to maintain low interface impedance, which limit their applications in long-term monitoring of biopotentials such as electroencephalogram (EEG). To address this problem, microneedle electrode arrays (MNEAs) have been employed as dry electrodes, which could be capable of EEG monitoring without skin abrasion and gel electrolyte. However, most of them are usually based on rigid substrates that are not conformal to curved and moved human skin. Therefore, we develop a flexible parylene-based MNEA (P-MNEA) with silicon microneedles, which could provide not only conformal but also robust contact. Firstly, the microfabrication process is concretely illustrated and makes it repeatable. Then, penetration tests illustrate these microneedles are robust enough to penetrate into epidermis so that impedances of stratum corneum make limited contribution to interface impedance. Consequently, *in vivo* impedance results verify the priority of P-MNEA in long-time impedance stability. Meanwhile, competitive impedance density of 7.5 KΩ*cm^2@10Hz is attained. Eventually, EEG recoding results as well as correlation and coherence analyses of P-MNEA indicate comparable performance to that of wet electrode. In brief, these results reveal promising prospect of P-MNEA in long-time EEG monitoring.**

Index Terms— Flexible; Microneedle; Dry electrode; EEG; Parylene

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