2D MoS_2-based array for high-resolution electrocorticography signals

DUO XU
Juyeong Hong, Jong-Hyun Ahn*
Department of Electrical and Electronic Engineering, Yonsei University, Seoul, Republic of Korea
ahnj@yonsei.ac.kr

Abstract

Prominent advancements in neurophysiologic monitoring have led to an unprecedented understanding of cortical functions [1]. The ideal neural interface with the ability to monitor large populations of neurons at the high spatial and temporal definition, however, how to balance signal fidelity and sampling density is a pressing need and challenge now [2]. In this research, we proposed a 2D MoS_2-based sensing array for electrocorticography (ECoG) signals, demonstrating the ultra-high resolution spatiotemporal recording.

The wafer-scale fabrication of MoS_2 active arrays was validated on a 4-inch PI/sapphire substrate (Fig. 1) that can be transferred through water. The array output current I_d is read out by corresponding amperometric circuits [3]. Furthermore, our MoS_2-based array presents adequate mobility and high ON/OFF ratio of TFTs, which are essential prerequisites for fast-speed multiplexing, high-density sampling, and low crosstalk noise.

The high spatiotemporal resolution allows our MoS_2 array to precisely record epileptiform activity, demonstrating the reproducible correlations of 95% in brain-like settings (Fig. 2). The corresponding spectrogram in the 0.5−250 Hz band presents the classical epileptiform spikes can be clearly distinguished.

References

[1] Garcia-Cortadella, R., Schwesig, G., Jeschke, C. et al., Nat. Commun. 12, (2021) 211.
[2] Chia-Han Chiang et al., Sci. Transl. Med. 12, (2020) eaay4682.
[3] Yu, K., Kuzum, D., Hwang, SW. et al., Nat. Mater. 15, (2016) 782–791.

Figures

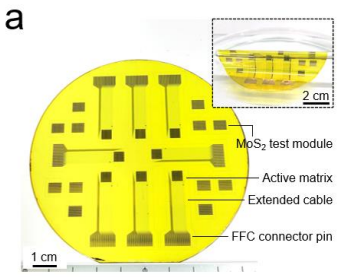

Figure 1: (a) Schematic of the 4-inch wafer-scale fabrication of MoS_2 arrays.

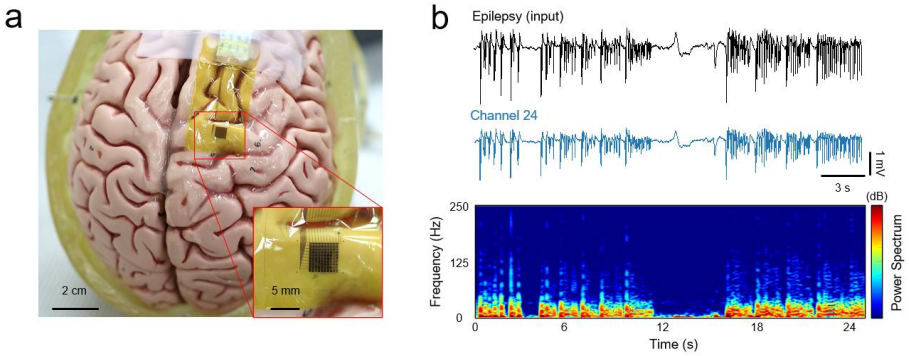

Figure 2: (a) Brain-like settings of neural interface for (b) the precise recording of epileptiform activity with the time-frequency spectrogram in the 0.5−250 Hz band