Epidural electronics based on graphene electrode array for epilepsy electrotherapy

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In recent decades, bio-engineered electronics for monitoring brain health and applying powerful therapies have been attractive research field because brain diseases are fatal, chronic and caused of complicated brain disorders [1-2]. Among all manner of ways for brain therapy, the electrical stimulation (electrotherapy) is one of the most effective methods for medical treatment of brain diseases [2-3]. Previous major means of electrotherapy for epilepsy is penetrating metal electrode, which is deeply invasive inside brain. However, the invasive method could cause serious inflammation and damage to brain. Here, we propose non-invasive and conformal graphene-based electrode array for electrophysiological diagnosis and electrotherapy of epilepsy. The single carbon-atomic graphene has chemically inert surface, good bio-compatibility and transparency. These main properties of graphene enable excellent bio-compatible electrode array. Also, its great electrochemical characteristics induced by electrical double layer on its surface show superior measuring performance in tissue interface [4]. With graphene electrode array, we develop ultra-thin conformal devices (Fig. 1). The electrode spacing is designed by the neural activity resolution of cortical network [5]. The measuring and stimulating electrodes are separately located in this work. Fig. 2 shows the electrotherapy process, which is composed of detecting seizure signal, electrically stimulating and checking the health of neural tissues after stimulation. This work is published on Small for front cover in July, 2018 [6].

References

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Figures

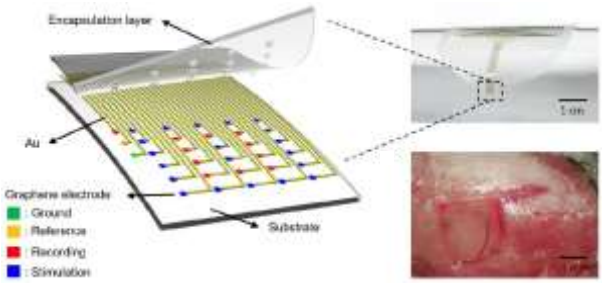

Figure 1: Graphic scheme of graphene electrode based ultrathin bio-devices (left side) and its optical image with transferred on glass bar and in-vivo tissue of rat brain (right side).

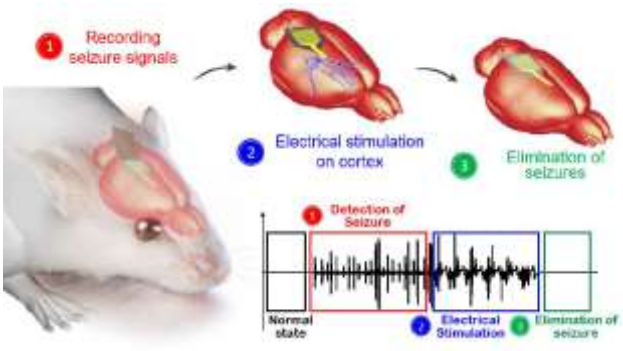

Figure 2: Graphic scheme of process of electrotherapy. The data is raw data in-vivo measurement, which result from graphene electrode.