Wireless, graphene-based multifunctional EEG and ECG sensor for clinical monitoring

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With the advent of advanced digital healthcare technologies, the need for imperceptible user-friendly portable devices for clinical monitoring of physiological anomalies has greatly increased [1]. The brain and the heart are two major organs that would benefit greatly from such real-time monitoring apparatus, as the symptoms of various diseases readily manifest themselves in their operation. Brain diseases, such as stroke, epilepsy, and Parkinson's disease, and cardiovascular diseases, including arrhythmia, heart attacks, and atrial fibrillations, known for their high fatality, are among the many conditions where quick diagnosis and preventative measures may be taken via the continuous monitoring of the brain and the heart. As a result, electroencephalogram (EEG) and electrocardiogram (ECG) have become essential tools in the monitoring and diagnosis of patients. However, conventional monitoring devices are hard-pressed to facilitate prolonged real-time monitoring of patients. These devices typically fail to support the simultaneous monitoring of vitals on a single wearable device and cause discomfort owing to the bulky, wired electrodes and recording devices, thus limiting their daily use and leaving patients vulnerable to unpredictable medical emergencies [2]. Here, we demonstrate a wireless, graphene-based EEG and ECG sensor with improved accuracy for clinical monitoring. The ultrathin and imperceptible graphene-based electrodes exhibit lower contact impedance, high signal-to-noise ratio (SNR), and stable properties owing to the excellent mechanical and electrical properties of the constituent materials and structural design. Paired with a high-throughput portable wireless recording device for clinical monitoring, the system enables user-friendly, real-time monitoring of EEG and ECG for up to 11 hours on a single charge with accuracy and precision on par with that of conventional clinical systems. The simultaneous monitoring of both EEG and ECG enables accurate and holistic analysis of the patient's status, demonstrating highly accurate diagnosis for various stress and sleep states.

References

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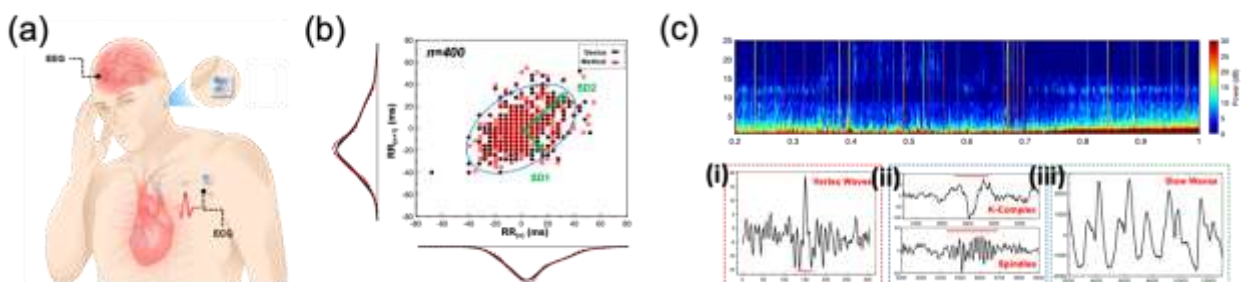
Figures

Figure 1: (a) Schematic illustration of the graphene-based electrode array and the wireless recording device. (b) Comparison of R-R variance between medical ECG device and the graphene-based device. (c) Diagnosis of sleep states.