

Carbon Based Wearable Patch Devices for Real-Time Electrocardiography Monitoring

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Abstract : We fabricated a wearable patch device including novel patch type flexible dry electrode based on carbon nanofibers (CNFs) and silicone-based elastomer (MED 6215) for real-time ECG monitoring. There are many methods to make flexible conductive polymer by mixing metal or carbon-based nanoparticles. In this study, CNFs are selected for conductive nanoparticles because carbon nanotubes (CNTs) are difficult to disperse uniformly in elastomer compare with CNFs and silver nanowires are relatively high cost and easily oxidized in the air. Wearable patch is composed of 2 parts that dry electrode parts for recording bio signal and sticky patch parts for mounting on the skin. Dry electrode parts were made by vortexer and baking in prepared mold. To optimize electrical performance and diffusion degree of uniformity, we developed unique mixing and baking process. Secondly, sticky patch parts were made by patterning and detaching from smooth surface substrate after spin-coating soft skin adhesive. In this process, attachable and detachable strengths of sticky patch are measured and optimized for them, using a monitoring system. Assembled patch is flexible, stretchable, easily skin mountable and connectable directly with the system. To evaluate the performance of electrical characteristics and ECG (Electrocardiography) recording, wearable patch was tested by changing concentrations of CNFs and thickness of the dry electrode. In these results, the CNF concentration and thickness of dry electrodes were important variables to obtain high-quality ECG signals without incidental distractions. Cytotoxicity test is conducted to prove biocompatibility, and long-term wearing test showed no skin reactions such as itching or erythema. To minimize noises from motion artifacts and line noise, we make the customized wireless, light-weight data acquisition system. Measured ECG Signals from this system are stable and successfully monitored simultaneously. To sum up, we could fully utilize fabricated wearable patch devices for real-time ECG monitoring easily.

Keywords : carbon nanofibers, ECG monitoring, flexible dry electrode, wearable patch

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