Silver Nanowire On-Skin Flexible Electrodes for Electrophysiological Monitoring

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Most human body movements are driven by low-level electrical potentials - electrophysiological (EP) signals. In order to capture and track these EP signals, electrodes must be used. Conventional Ag/AgCl electrodes have many limitations and are not suitable for future wearable EP signal monitoring devices. Flexible on-skin electrodes have received tremendous attention in the past few years and are critical components of these future devices. High electrical conductivity, flexibility, and adhesion on the skin are key requirements for such electrodes. Much research work has been done in the past years to develop various types of on-skin electrodes, but all these electrodes require extremely complicated fabrication processes. This research work aims to create an on-skin electrode that will be able to replace Ag/AgCl electrodes through a simple and effective process. In this research project, we successfully developed a novel on-skin flexible electrode prototype by combining highly conductive silver (Ag) nanowire (NW) with highly flexible and tacky silicone adhesive film. Due to the superior electrical conductivity of silver, AgNWs provide the electrode with high conductivity. The silicone will offer outstanding adhesion on skin and stretchability to ensure low skin contact impedance and comfort for users. Among the three different processes we investigated, we were able to identify one novel and simple process to effectively transfer a thin layer of AgNWs onto the surface of the silicon film. The fabricated electrode prototype met all the electrical and mechanical requirements and demonstrated the feasibility as a potential electrode for future wearable EP monitoring devices.