Flexible Pet-Based Ito Interdigitated Electrodes For Wearable Bio-Impedance Blood Pressure Sensing

Min-Haw Wang*, Pei-Shan Chen, Wei-Yu Chen

Department of Electrical Engineering, Chinese Culture University, TAIWAN

Abstract

This study aims to develop a flexible bio-impedance sensing system for non-invasive blood pressure monitoring by addressing the limitations of conventional rigid electrodes, which often suffer from unstable skin contact and motion-induced signal artifacts [1]. To improve contact sensitivity and wearability, indium tin oxide (ITO) thin-film electrodes fabricated on a polymer substrate are proposed. Owing to its high electrical conductivity, optical transparency, and compatibility with flexible electronics, sputtered ITO is a promising material for wearable biomedical sensing applications [2]. By integrating flexible interdigitated electrodes with a bio-impedance measurement approach, the proposed system seeks to enable stable pulse-related signal acquisition while maintaining user comfort during continuous physiological monitoring [3].

The flexible bio-impedance electrodes were fabricated using commercially available polyethylene terephthalate (PET) substrates with a thickness of 125 μm, coated with ITO thin films. Two ITO configurations were employed, featuring resistivity values of 5 and 10 Ω·m²/m, optical transmittance exceeding 75%, and thicknesses of 3500 Å ± 300 Å and 1850 Å ± 200 Å, respectively. Interdigitated electrode patterns with dimensions of 2.75 cm × 1.5 cm were designed to enhance sensitivity to impedance variations. Figure 1shown the fabrication process involved standard photolithography techniques, including substrate cleaning, photoresist coating, ultraviolet exposure, post-exposure baking, development, hard baking, and wet chemical etching. To ensure surface flatness and mechanical stability during processing, the PET-ITO substrate was temporarily bonded to a rigid carrier wafer. The resulting flexible electrodes as shown in Figure 2 exhibited uniform pattern definition and mechanical robustness suitable for wearable use.

Experimental evaluation demonstrated that the fabricated PET-ITO electrodes possess excellent mechanical flexibility and electrical stability, allowing conformal contact with curved skin surfaces without cracking or delamination. When applied to the forearm near the radial artery, the flexible electrodes successfully detected pulse-induced bio-impedance variations associated with arterial activity. Compared with rigid electrodes, the proposed ITO-based flexible electrodes showed improved contact consistency and reduced motion-related artifacts. These results confirm the feasibility of using PET-supported ITO thin-film electrodes for wearable, non-invasive blood pressure monitoring and highlight their potential for integration into next-generation flexible and printable biomedical sensing systems.

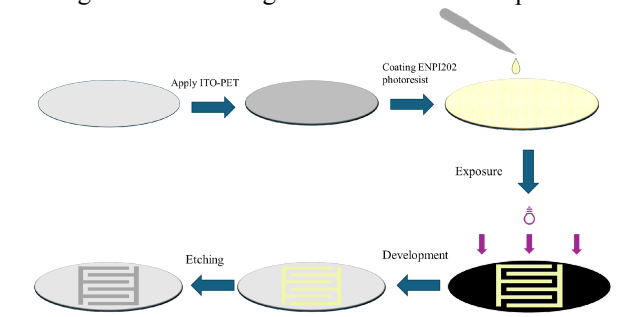

Figure 1 Flexible electrode process

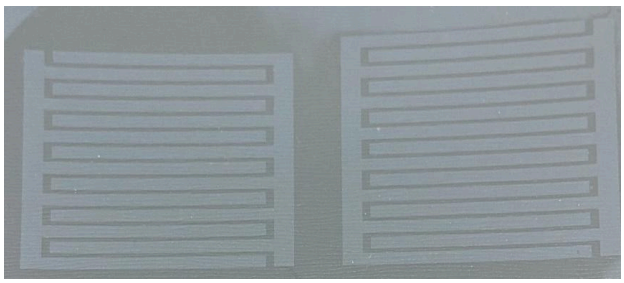

Figure 2 Flexible electrodes

References

[1] J. G. Webster, *Medical Instrumentation: Application and Design*, 4th ed. Hoboken, NJ, USA: Wiley, 2010.

[2] S. Khan, L. Lorenzelli, and R. S. Dahiya, “Technologies for printing sensors and electronics over large flexible substrates: A review,” *IEEE Sensors Journal*, vol. 15, no. 6, pp. 3164–3185, Jun. 2015.
[3] T. Yilmaz, R. Foster, and Y. Hao, “Detecting vital signs with wearable wireless sensors,” *Sensors*, vol. 10, no. 12, pp. 10837–10862, Dec. 2010.