Nanoweb fabric pressure sensor using complex impedance variation

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Abstract: We developed fabric based pressure sensors with PU or PVDF nanoweb to improve the sensitivity. Sandwiched structure of new fabric sensor with PVDF provided the high sensitivity when using complex impedance variation. It also showed better hysteresis, creep and relaxation property. The new fabric sensor will be used to measure pressure distribution *via* impedance imaging .

1 Introduction

For a gait analysis and pressure sore imaging, there is a demand to measure the pressure distribution on a large area. Plenteous single cell based pressure sensors have been used as an array type. However, this kind of array pressure distribution sensor is required a complex manufacturing process and has a large crosstalk among multiple signals, thick, heavy and too costly. In order to integrate with wearable healthcare monitoring system, we considered conductive fabric materials for costless and flexibility and resistance changes depending on the amount of pressure. Unfortunately, the resistance variation is determined by the intrinsic property of commercial conductive fabric materials and its variation is small.

Recently, we developed the fabric pressure sensor combined with nanoweb to increase the complex impedance variation for pressure change. In the preliminary test, we present the basic properties of the new fabric pressure sensor for a gait analysis and pressure sore imaging.

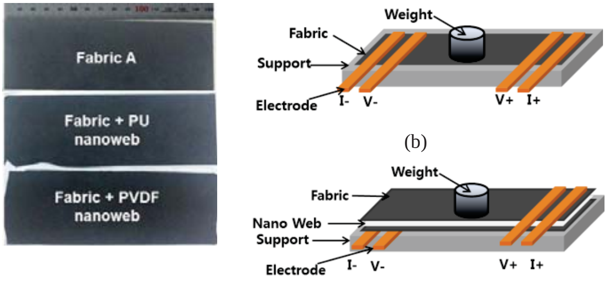
2 Methods

2.1 Materials

We prepared three types of pressure sensors using commercialized conductive fabric, polyurethane (PU), and polyvinylidene fluoride (PVDF) in Figure 1(a). A conductive fabric of 15×5 cm^2 was cut for the first sensor. The second sensor was made up of a piece of PU nanoweb sandwiched in two pieces of same conductive fabric. The third sensor was the same as the second sensor except of exchanging the PU to PVDF. The PU and the PVDF were prepared by electro-spinning process. The thickness of all sensors were less than 300 μm. Since all of them has a large air space inside, they are good for air permeability.

2.2 Evaluation methods

We evaluated the sensitivity of pressure sensors when applying the 25 gm weight to the sensors up to 300 gm in the measurement configuration as shown in Figure 1(b) and (c). For testing the creep and relaxation of the fabric sensors, 300 gm weight applied at the centre of fabric for 100 seconds and removed it for another 100 seconds, repeatedly. We acquired impedance values for 20 minutes. We tested hysteresis of sensors and timing response in the same configuration.



(a) (b) (c)

Figure 1: (a) Three kinds of fabric pressure sensors and measurement configuration for impedance of (a) conductive fabric and (b) fabric with nanoweb sensors.

3 Results and conclusions

From the sensitivity evaluation for three different sensors, the variation of impedance in fabric with PVDF nanoweb had the largest changes due to the applied pressure because of large amount of changes in imaginary part. Also, the selection of sensing frequency was important and it provided the characteristic for fabric material and weaving methods. There was a creep and relaxation of fabric sensors when applying pressure continuously and after removing the weight. To reduce them, we applied age forming with high pressure. The new fabric sensor with PVDF produced better hysteresis and timing response than intrinsic commercial conductive fabric sensor. We may produce high sensitive impedance images with the new fabric sensor.

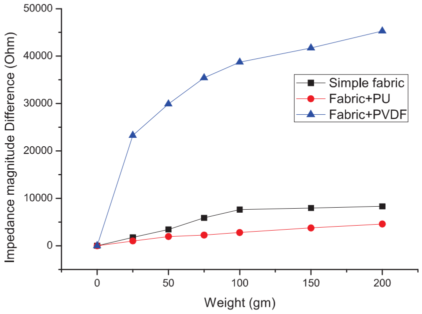


Figure 2: Magnitude of complex impedance variation of three different fabric sensors according to increasing weights.

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