

Developing a Pressure Sensor for 3D Nonwoven Assemblies by Using Novel Spacer Stitching Technology

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Abstract:

Three-dimensional textile fabrics can be thick planar sheets or shaped solid forms with multiple layers of yarns, hollow structures, or thin three-dimensional shells (1). The spacer fabrics have a wide range of applications such as mobile textiles (2), electronic textiles (3), industrial textiles (4), medical textiles, and sports textiles (5).

Nowadays woven and knitted spacer fabrics are widely used for different applications (6). However nonwoven spacer fabrics are novel and not widely used compared to woven and knitted spacer fabrics (7). Non-woven fabrics are characterized by a voluminous and bulky structure, which is similar to the structure of spacer fabrics. In this study, a pressure sensor was developed by taking advantage of nonwovens' hollow and voluminous structure.

For this purpose, a carded web was created using biodegradable polylactic acid (PLA) and milkweed fibers. The strength of the web was increased with needle-punching process. Needle-punched nonwoven was cut into 5x5 cm dimensions and conductive yarn was fixed on its upper and lower surfaces. The sample intended to be used as a pressure sensor so that it is integrated into a simple electrical circuit. Finally, it was determined that current flowed through the conductive yarn when pressure was applied to the needle-punched nonwoven fabric.

Further properties such as capacitance values depending on fabric thickness, washing fastness, and resistance changes under pressure were investigated in this study.

As a result of the study, it was revealed that nonwoven fabrics can be used in different applications such as pressure sensors by taking advantage of their natural structure.

Keywords: 3d spacer fabric, needle-punching, milkweed fibers, electronic textiles.

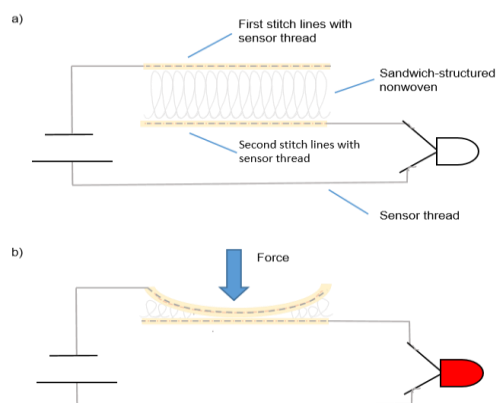
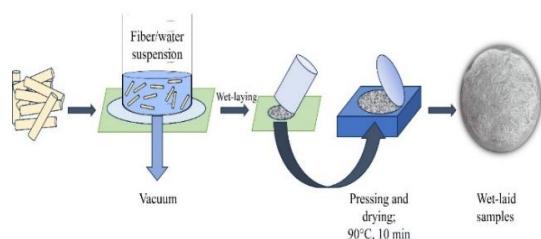


Figure 1. Illustration of the needle punched pressure sensor. The nonwoven fabric can be utilized as an open switch when released (a), and as a closed switch when gripped (b).

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