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Smart textiles with optical fibre implementation

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Smart textiles can be characterized by their ability to capture information from the environment, for example body physiological data. The sensors used are then integrated and are a part of these textiles. The goal of this study is to develop smart textiles whose sensor element is a new polymeric optical fiber. This fiber is flexible, elastic and compressible. When the fiber undergoes deformation, some of the light circulating in its core leaves the fiber, allowing force causing this deformation to be measured as friction, compression or tension. However, the connection between the sensor fiber and rigid elements, light source, photodiode should not influence the measurement and the path of the fiber inside the textile structure should be chosen regarding the measuring objective.

Keywords: smart textiles, optical fibers, friction, sensors, body monitoring,

1. Introduction

Human being used to wear cloths to protect themselves against nature and risks, so the textile interaction of sensors is turning into a major concern for the measure of physical and physiological parameters of human body.[1] The aim of this study is to develop an approach for the integration of specific Polymeric Optical Fibers (POFs) in textiles. A previous study shown it is necessary to improve the connection between a flexible POF and the electronical elements and to improve the path in the textile structure regarding the investigated kind of stress (compression, friction, tension) [2].

2. Methods

The aim of the measurement is based on the study of the light transmitted by the POFs. When the sensor fiber deforms under mechanical stress, part of the light leaves the fiber. In order to have a highly sensitive sensor, a maximum amount of light must pass through the fiber to quantify the strains as accurately as possible. In order to achieve this goal, the connection of the fibers and their light exchange surfaces must be optimal. To facilitate their integration by an industrial process into textile structure specific a POF very elastic and flexible has been developed. However, a specific connection procedure with light source and photodiode has been developed and tested (Figure 1).
The objective is to determine the best trajectory of the fiber in plane of the textile structure in order to measure a tangential stress (friction) or a normal stress (compression). Then, the sensitivity to this POF to different kinds of mechanical stress has been studied: transversal compression and bending.

3. Results

The connection developed has been proved to be efficient because a first integration of a sensor fiber in a knitted fabric has been realized. Moreover, it allows the measurement of in the sensing zone and no influenced by external disturbances such as bending and compression outside this zone.
The irradiance relative to force during transversal compression is highlighted in Figure 2.

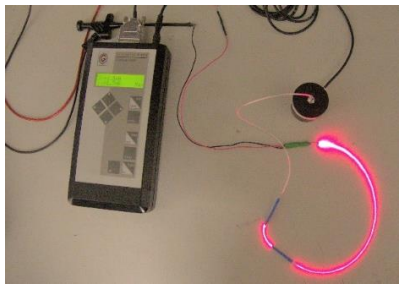

Figure 1: Complete system: the sensor fiber assembled with two multifilaments. The laser diode delivers light with a wavelength of 665 nm and the photodiode receives the light and sends the data to the display. The sensitive part is located between the two heat shrink sheaths.

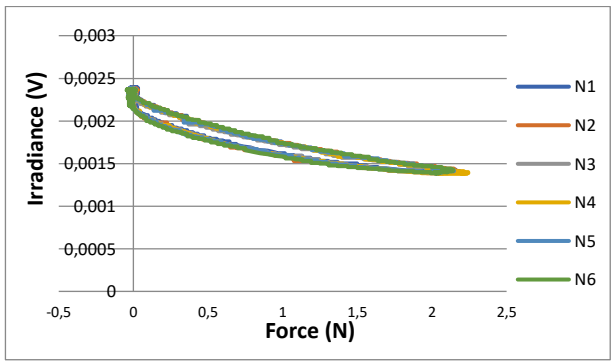

Figure 2: Irradiance from the POF relative to compression force. 6 measurements on the same POF are represented.

4. References

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