Optical Force Sensors for Smart Prostheses

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I. Introduction

In the medical sector, there is an increasing need for several kinds of conformable sensors which can be applied on moving or curved surfaces such as the human body or prostheses. Furthermore, optical sensors are favorable since they do not suffer from electromagnetic interference and are potentially more sensitive. Therefore, mechanically very flexible optical sensors were developed to measure shear forces for these medical applications.

II. Methods

The operation of the shear sensor relies on the changing coupling between a light source and optical detector, separated by a deformable sensing layer (Figure 1). When idle, the detector measures the maximum amount of light, but this detector signal decreases with increasing lateral displacement or shear force. Since the sensor is embedded in very thin and flexible materials [1], it is ideally suited to be used on curved or moving parts such as prostheses.

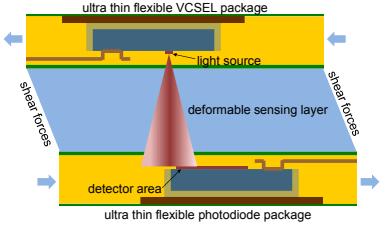

Figure 1. Sensor principle: changing optical coupling induced by exerted shear force.

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III. Results

The sensor was tested by applying a shear force using a Dage series 4000 bond tester and simultaneously measuring the sensor output, for different supply currents. From Figure 2, it can be noticed that the sensitivity is highest at 5mA supply current and the response is nearly linear in the largest part of the range.

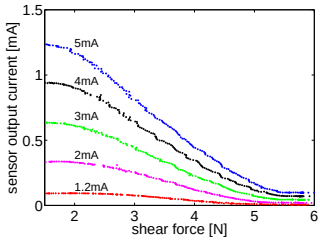

Figure 2. Measured sensor characteristics: sensor output current versus applied shear force.

IV. Conclusions

A thin and mechanically very flexible optical shear sensor was fabricated and tested. Moreover, the mechanical sensor properties make it ideally suited for using with continually moving prostheses with curved surfaces.

Acknowledgments

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References

[1] E. Bosman, G. Van Steenberge, B. Van Hoe, J. Missinne, J. Vanfleteren, and P. Van Daele, *Highly reliable flexible active optical links*, IEEE Photon. Technol. Lett., vol. 22, no. 5, pp. 287–9, 1 March 2010.