Summary of PhD Thesis entitled:

FIBER OPTIC SENSORS BASED ON SURFACE PLASMON RESONANCE EFFECT FOR REFRACTIVE INDEX MEASUREMENTS

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The goal of this Thesis was to develop and characterize new fiber-optic surface plasmon resonance sensors for refractive index measurements, which show good metrological parameters and can be fabricated using simplified technological processes, thanks to the use of fibers of special construction.

In the first step of the conducted research, commercially available multimode step-index polymer optical fibers were used to fabricate the SPR sensors. It was shown that in the side-polished straight fibers, the strength of the SPR effect depends predominantly on the sensing length and not the polishing depth. It was also demonstrated that enhancement of the SPR effect can be achieved by bending the fiber. The obtained results allowed to design and fabricate the D-shape microstructured polymer optical fibers. The process of sensors fabrication was significantly simplified for the D-shape fibers because the metal layer can be deposited directly on the flat surface of the fiber. The effect of SPR strength enhancement by fiber bending was also confirmed.

In the next step, the single-mode D-shape optical fibers were fabricated and investigated. The D-shape fiber design allowed to avoid the technologically difficult process of exposing the fiber core. Because, the investigated fibers exhibited modal birefringence, it was possible to determine the position of the resonant wavelength using two measurement techniques, i.e., the transmission method and the phase shift method. An important result of the thesis is the experimental demonstration that the detection accuracy for the phase shift measurement method is much better than for to the transmission method.

The results obtained in this thesis prove that thanks to the use of the optical fibers of special construction, it is possible to fabricate SPR fiber sensors with good metrological parameters and simultaneously avoiding the technologically difficult process of exposing the fiber core. In addition, it was proved that it is possible to improve the resolution of the SPR fiber sensors by using the phase shift measurement method. Another important results of the thesis was the demonstration of the possibility of improving the sensor's metrological parameters by fiber bending.