Microstructured optical fibers - new sensing opportunities and a new fabrication process (3D printing)

Cristiano M. B. Cordeiro

Instituto de Física – Universidade Estadual de Campinas (UNICAMP) / Brazil

cmbc@ifi.unicamp.br

In this talk some of our recent work at the Institute of Physics at Universidade Estadual de Campinas (UNICAMP) will be presented.

Microstructured optical fibers are special fiber that have an array of tinny air holes that run parallel to the fiber axis along all its length. Such structures revolutionized the field of guided optics, including fiber optical sensors, due the great flexibility in choosing its optical and mechanical properties. By properly arranging the position, size and shape of the microstructure very complex designs can be realized and fibers highly sensitive to some external parameter can be modeled and fabricated. In the case of hydrostatic pressure sensors, for example, the main concept is to produce an asymmetric distribution of the air channels within the fiber cross section in order to obtain a fiber whose birefringence is highly pressure dependent. In our work we proposed a new route to get such high sensitivity by playing with a very simple fiber geometry, a capillary with and embedded core. A simple analytical model was studied to help understand how the capillary thicknesses and core position impact the sensor sensitivity. Our findings and the experimental realization will be presented.

Another way to simplify the field of microstructured optical fibers is to change how such fiber preforms (the macroscopic version of the fiber) are produced. In this talk I will present how a commercial desktop 3D printer can be used to produce the polymeric preforms that are subsequently pulled to optical fibers. This new fabrication technique is transforming how things are made and, in our case, allows the production of a great variety of fiber geometries, both solid and hollow core ones.