UNIVERSITY of DAYTON

ABSTRACT

WET ETCHING TAPERED OPTICAL FIBERS TO SUB-MICRON DIAMETERS FOR SENSING APPLICATION

Denfense: January 23, 2014
11:00 am – CPC 580
All are invited

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In this thesis we explore a novel technique to fabricate sub-micron diameter tapered fibers for sensor applications. Physically the light propagating in a tapered fiber has an evanescent field that extends into the medium surrounding the fiber containing an analyte. A sub-micron diameter taper can expels most the electromagnetic energy into the medium thus increasing the sensitivity of the measurement. The tapering process we develop enables us to have precise control over the final diameter of the taped fiber's waist. The tapered single mode fiber sensors (TSMFs) are fabricated using a two-step procedure. First, a single mode fiber is tapered to about 10 microns using Vytran Glass Processing System. Second, we etch the TSMFs with 6:1 buffered HF solution to a controlled sub-micron size. During the etching process we monitor the fiber's progress by measuring the transmittance characteristics. The in situ measurements are made by connecting a laser at one fiber end and using a photodetector to measure the transmittance the other end. We find a temporal modulation of the transmittance during the etching process, which is due to the changes in the propagation constants of the fiber modes. The details of this device are described and its optical properties are examined in this thesis.

To better understand the transmission characteristics recorded in the experiment we develop a simulation of the optical power propagating through the tapered fiber to calculate the transmitted power. We apply a Beam Propagation Method (BPM) to simulate the light wave passing through the tapered fiber sensor. We numerically analyze the transmittance characteristics of the beam oscillating inside the TSMFs. Our simulations are applied to validate the experimental results.

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