Measurement of relative humidity using Gelatin-coated multilayer fiber

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1. Introduction

Humidity is one of the most important parameters that needs to be controlled in various fields namely, environment monitoring, food processing, medicine, paper and semiconductor industries [1-2]. In this article, we report our recent research on measurement of relative humidity using multilayered fiber coated with hydrophilic polymer layer. We choose gelatin as the prime element to sense the change in relative humidity (RH) in the atmosphere due to fast response and reversible nature within a wide RH range [3-4]. We first reduced the fiber dimension to a few microns using flame heated taper drawing technique and then coated the fiber with gelatin gel.

2. Sensing probe fabrication

Figure 1 shows the schematic of the tapered optical fiber and the corresponding refractive index profile. Here a standard single mode fiber (S405-XP, Thorlabs) is tapered to a waist of 11 μm and length 5 mm by uniform heating and control pulling using a butane torch. Then, in order to synthesize the sensing element, powdered gelatin (5% by weight) is dissolved in distilled water and is heated to 65^{0}C for 15 minutes to form an aqueous solution. The tapered region of the test fiber is then dipped into a small drop of the solution to form a uniform coating of gelatin gel.

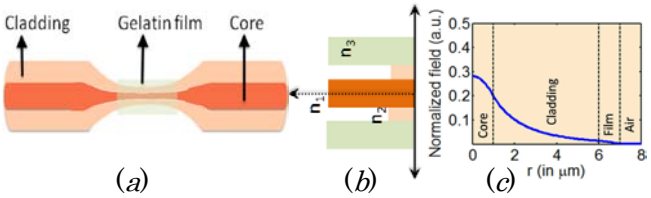

Fig.1. Schematic of (a) Sensing probe (b) Refractive index profile (c) Radial field profile

3. Experimental results and discussion

Figure 2 shows the schematic of the experimental setup. Now, in order to measure the relative humidity using fabricated gelatin coated multilayered fiber (sensor probe), the whole experiment is carried out in a sealed glass chamber

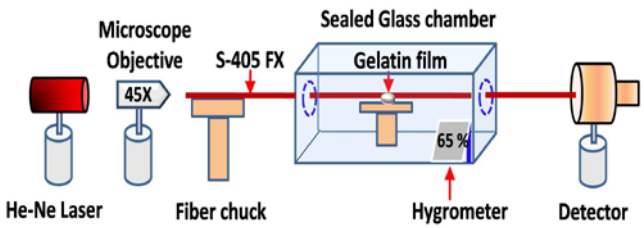

Fig.2. Schematic of the experimental setup

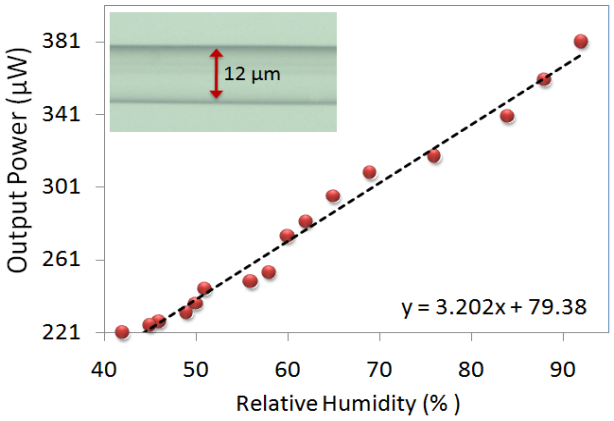

Fig.3. Humidity response of sensing probe (inset) Gelatin coated fiber probe

with a gas flowing facility. A digital hygrometer is placed in the chamber to monitor the humidity and temperature. The input-end of the fiber is connected to He-Ne laser (λ=632.8 nm) and the output is obtained from a photo-detector (S-260) which is connected to a UDT Optometer. When exposed to moisture, the change in refractive index of the gelatin layer changes the mode field of the guided mode of the coated fiber, resulting in RH-dependent transmission characteristics for optical sensing (see Fig.3).

4. Conclusion

We report an experimental method to measure the relative humidity using a standard optical fiber coated with hydrophilic polymer material (Gelatin). A linear response of the output power is found with the change in RH from 40% to 92%. An optimization recipe of such a sensing configuration is underway and would be presented in the symposium along with the worked out theoretical formulation.

Acknowledgement

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