Effect of Size and Humidity Variations on Rhenium Disulfide-coated Fiber Optic Humidity Sensors: Experimental Analysis and Performance Evaluation

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ABSTRACT

The correlation between humidity control, measurement, and daily human life is significant. Precise humidity measurement plays a crucial role in various applications, including industrial manufacturing, agricultural output, environmental monitoring, and food safety. This research focuses on the development and evaluation of a fiber optic humidity sensor incorporating rhenium disulfide (ReS₂) as a sensitive coating material. Leveraging the unique electronic and optical properties of ReS₂, a two-dimensional material, it is applied as a coating on the surface of the fiber optic sensor. The experiment begins with fabricating tapered optical fibers using the pull-heat method to achieve diameters of 4 µm, 7 µm, and 10 µm. The tapered fiber is then connected to a tunable laser light source and an Optical Spectrum Analyzer to assess sensor performance under humidity levels ranging from 40% to 80% RH. The sensor’s performance is analyzed in terms of sensitivity and linearity with the ReS₂-coated fiber optic humidity sensors. The results indicate that tapered fibers with diameters of 4 µm, 7 µm, and 10 µm coated with rhenium disulfide exhibit increased sensitivity compared to non-coated fibers. Specifically, the ReS₂-coated sensors demonstrated a 6–8% improvement in sensitivity for the 7 µm and 10 µm fibers under relative humidity conditions of 40% to 80% RH. In conclusion, coating optical fibers with ReS₂ enhances sensor sensitivity, making them more effective for environmental humidity sensing.

**Keywords:** Fiber optic sensor, humidity sensor, rhenium disulfide, ReS2 coating, optical properties