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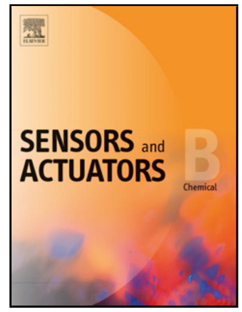

Title: A high response polyimide fiber optic sensor for distributed humidity measurements

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A high response polyimide fiber optic sensor for distributed humidity measurements

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Highlights

- An optical fiber was coated with polyimide layers of varying thickness the range 15 μm to 1.3 mm.
- The humidity induced strain response increased hyperbolically with coating thickness.
- Linear and reversible humidity induced strain responses up to 38.5 ± 1.9 με / % RH were observed.
- The humidity induced strain response time increased sub-quadratically with coating thickness.

Abstract

The humidity induced strain response along a length of optical fiber coated with polyimide layers of varying thickness up to 1.3 mm was characterized using Optical Frequency Domain Reflectometry. The measured strain response to humidity increased with coating thickness, and response values up to 38.5 ± 1.9 με / % RH were observed. This is far higher than in previous studies of polyimide coated optical fibers, where thinner coatings were applied. The response time, hysteresis and temperature response characteristics of the fiber are also reported. High coating thickness polyimide coated optical fibers with similar properties to those demonstrated here could be suitable for application in cost effective distributed humidity sensing systems.

Keywords: Fiber optic sensors; distributed chemical sensing; relative humidity.

1. Introduction

The research of fiber optic based techniques for humidity measurement have received a lot of attention in recent years [1-3]. This is in part due to the general attractiveness of fiber optic sensors, such as their small size, immunity to electromagnetic radiation, and multiplexing ability. Fiber optic humidity sensors in particular are less prone to failure at high humidity and high temperature than their electronic counterparts. Fiber optic humidity sensing techniques often involve the application of a humidity sensitive material to an end face of an optical fiber or are integrated with the cladding structure, which undergoes a change in the refractive index as the ambient humidity changes [4-6]. Other architectures incorporate additional mechanical elements that impart losses into the waveguide as the humidity changes [7-8].