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Optical Fiber Hydrogen Sensor with Single Sagnac Interferometer Loop Based on Vernier Effect

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Highlights

- This is the first time to propose an optical fiber hydrogen sensor with single sagnac interferometer loop based on vernier effect. We achieve the vernier effect in single sagnac interferometer loop by angle shift splicing two PMFs.
- The temperature sensitivity is $-2.44\text{nm}/^\circ\text{C}$, which magnifies 14.96 times compared with the sagnac sensor without vernier effect ($-0.163\text{ nm}/^\circ\text{C}$).
- 3. The hydrogen sensitivity is $-14.61\text{ nm}/\%$ within the range of $0\%-0.8\%$, which is 1.85 times higher than the sagnac sensor without vernier effect and is also related to the length of the PMF coated with Pt-loaded WO_3/SiO_2 . If the length of the PMF coated with Pt-load WO_3/SiO_2 powder adds to 4.3 cm in our experiment, the hydrogen sensitivity may achieve about $28\text{ nm}/\%$ in theory.

Abstract: An optical fiber hydrogen sensor with single Sagnac interferometer loop based on vernier effect has been proposed. The vernier effect is achieved by angle shift splicing two polarization maintaining fibers (PMFs) in single Sagnac interferometer loop. The hydrogen sensing length of PMF is 2 cm which is coated with Pt-loaded WO_3/SiO_2 powder. When the Pt/ WO_3 film is exposed to hydrogen, the redox reaction releases the temperature on the PMF, which induces the wavelength shift of the optical fiber sensor. The temperature sensitivity is $-2.44\text{nm}/^\circ\text{C}$ and the hydrogen sensitivity is $-14.61\text{ nm}/\%$ within the range of $0\%-0.8\%$ (vol%), which is 1.85 times higher than the Sagnac sensor without vernier effect. The hydrogen sensitivity is related to the length of the PMF coated with Pt-loaded WO_3/SiO_2 . The sensor is easy to fabricate, selective and high sensitivity.

Keywords: Optical fiber; Vernier effect; Sagnac interferometer; Hydrogen sensor; Temperature

1. Introduction

Hydrogen as a clean and sustainable energy has aroused wide attention [1-2]. And hydrogen can be used in a wide range of fields such as rocket engines and automotive

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