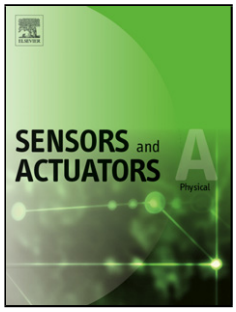

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Curvature Sensor Based on Mach–Zehnder Interferometer with Vase-Shaped Tapers

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Highlight

- A novel Mach–Zehnder Interferometer (MZI) formed by cascading two vase-shaped tapers in a single mode fiber (SMF) is proposed in this work. The vase-shaped taper is fabricated by fusion splicing a fiber sphere with a fiber tip under strong arc discharge.
- The curvature sensing characteristic of the proposed vase-shaped taper-based MZI is experimentally investigated, displaying that the interference spectrum has a blue shift with the increase of applied curvature. The sensor realizes a large range measurement of curvature from 0.9284 m^{-1} to 4.0470 m^{-1} with sensitivities of -8.41 nm/m^{-1} and -16.72 nm/ m^{-1} in the curvature range of 0.9284 m^{-1} to 2.4564 m^{-1} and 2.6025 m^{-1} to 4.0470 m^{-1}, respectively. It also shows a low temperature-curvature cross-sensitivity of -0.0016 m^{-1}/℃ and -0.00082 m^{-1}/℃ in the two measurement ranges, which are lower than the corresponding curvature resolutions that are 0.0024 m^{-1} and 0.0012 m^{-1}.
- The proposed sensor exhibits the advantages of low cost, negligible temperature cross-sensitivity, fine curvature sensitivity and large measurement scale.

Abstract

A novel Mach–Zehnder Interferometer (MZI) formed by cascading two vase-shaped tapers in a single mode fiber (SMF) is proposed in this work. The vase-shaped taper is fabricated by fusion splicing a fiber sphere with a fiber tip by applying strong arc discharge. The curvature sensing characteristic of the proposed vase-shaped taper-based MZI is experimentally investigated, displaying that the interference spectrum has a blue shift with the increase of applied curvature. The sensor realizes a large range measurement of curvature from 0.9284 m^{-1} to 4.0470 m^{-1} with sensitivities of -8.41 nm/m^{-1} and -16.72 nm/ m^{-1} in the curvature range of 0.9284 m^{-1} to 2.4564 m^{-1} and 2.6025 m^{-1} to 4.0470 m^{-1}, respectively. Its temperature-curvature cross-sensitivities are -0.0021 m^{-1}/℃ and -0.0011 m^{-1}/℃ in the two measurement ranges, which are lower than the corresponding curvature resolutions which are 0.0024 m^{-1} and 0.0012 m^{-1}. The proposed sensor exhibits the advantages of low cost, negligible temperature cross-sensitivity, fine curvature sensitivity and large measurement scale.

Keywords: optical curvature sensor; vase-shaped taper; Mach-Zehnder interferometer.