SnO_2 humidity interferometric sensor based on photonic crystal optical fiber and Fast Fourier Transform

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Abstract

In this paper we report a sensor based on a SnO_2 nanocoating sputtered onto an optical fiber interferometer for relative humidity (RH). This deposition technique achieves high reproducibility, a good long-time stability and precise control in the thickness of the coated nanofilm. The device consists of a photonic crystal optical fiber segment (PCF) spliced between two standard mono mode fibers. In the first spliced region, the voids of the PCF are collapsed allowing the recombination of PCF core and cladding modes [1]; when the modes reach the second spliced region, they yield to an interferometric response. Along the PCF segment, the cladding modes interact with SnO_2 nanofilm which is highly sensitive to RH. Figure A shows how different RH values shift the interferometric pattern due to the interaction with the SnO_2 coating. Fast Fourier Transform (FFT) is applied to the interferometric signal, using the phase variations to follow RH changes. FFT method offers some advantages such as the non-dependence of the signal amplitude and also avoids the necessity of tracking the wavelength evolution in the spectrum which improves the post process of the sensor response [2]. As it can be seen in Figure B, the resulting phase follows HR changes along the measuring range (20-90% RH) with a sensitivity of 0.01 rad/HR%; moreover, it shows a negligible cross correlation with temperature.

Figures:

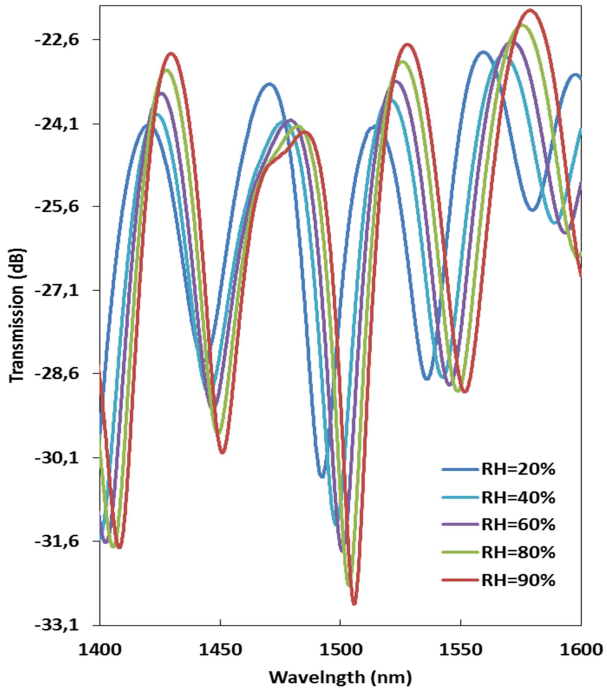

Figure A: Spectral shifts for different RH values

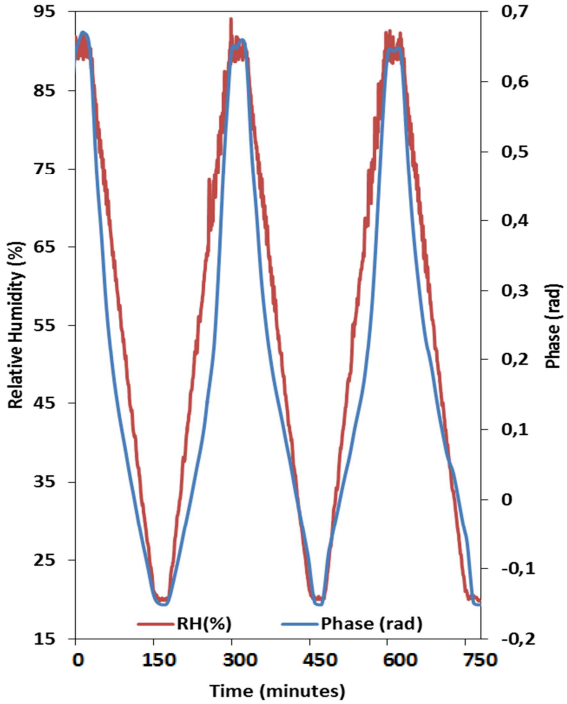

Figure B: Evolution of the FFT phase component for varying RH conditions

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References

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