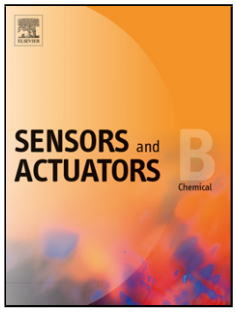

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Photonic Crystal Fiber Long-Period Grating Absorption Gas Sensor Based on a Tunable Erbium-Doped Fiber Ring Laser

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Abstract: It has been a persistent challenge to quantify gas emissions from industrial byproducts and warfare agents for environmental protection purposes, especially to detect multiple gas species using one device with high sensitivity and selectivity. To overcome this issue, a photonic crystal fiber (PCF)-based spectroscopic absorption sensing platform is proposed. We combine the PCF and long-period grating (LPG), two fundamental elements of fiber optics, into one functional unit to investigate the coupling properties of various PCF cladding modes. Further, we synchronize the PCF-LPG with a tunable Er-doped fiber ring laser into a thermo-stable and compact absorption spectroscopic sensor as a proof-of-concept for gas sensing. Because the Er-doped fiber ring laser can be tuned within the C-band wavelength, multiple gases can be recorded with the absorption spectra in one sensing operation. As a demonstration, the sensor was tested in NH_3 with multiple gases combined, a sensitivity up to 17.3 nW/ppm was achieved. The PCF-LPG-based gas sensors are easy-to-fabricate, cost-effective, and can be used in various applications where conventional fiber-optic sensors are not applicable.

Keywords: Photonic crystal fiber; long-period gratings; fiber-optic sensors; fiber ring lasers; absorption spectroscopy