High sensitivity microfiber interferometer sensor in aqueous solution

ABSTRACT

The need for environmental protection and water pollution control has led to the development of different sensors for determining many kinds of pollutants in water. Ammonia nitrogen presence is an important indicator of water quality in environmental monitoring applications. In this paper, a high sensitivity sensor for monitoring ammonia nitrogen concentration in water using a tapered microfiber interferometer (MFI) as a sensor platform and a broad supercontinuum laser as the light source is realized. The MFI is fabricated to the waist diameter of 8 μm producing a strong interference pattern due to the coupling of the fundamental mode with the cladding mode. The MFI sensor is investigated for a low concentration of ammonia nitrogen in water in the wide wavelength range from 1500–1800 nm with a high-power signal provided by the supercontinuum source. The broad source allows optical sensing characteristics of the MFI to be evaluated at four different wavelengths (1505, 1605, 1705, and 1785 nm) upon exposure towards various ammonia nitrogen concentrations. The highest sensitivity of 0.099 nm/ppm that indicates the wavelength shift is observed at 1785 nm operating wavelength. The response is linear in the ammonia nitrogen range of 5–30 ppm with the best measurement resolution calculated to be 0.5 ppm. The low concentration ammonia nitrogen detected by the MFI in the unique infrared region reveals the potential application of this optical fiber-based sensor for rivers and drinking water monitoring.

Keyword: Ammonia-nitrogen; Microfiber interferometer; Optical-fiber sensor