Sensitive leptospira DNA detection using tapered optical fiber sensor

ABSTRACT

This paper presents the development of tapered optical fiber sensor to detect a specific Leptospira bacteria DNA. The bacteria causes Leptospirosis, a deadly disease but with common early flu-like symptoms. Optical single mode fiber (SMF) of 125 μm diameter is tapered to produce 12 μm waist diameter and 15 cm length. The novel DNA-based optical fiber sensor is functionalized by incubating the tapered region with sodium hydroxide (NaOH), (3-Aminopropyl) triethoxysilane and glutaraldehyde. Probe DNA is immobilized onto the tapered region and subsequently hybridized by its complementary DNA (cDNA). The transmission spectra of the DNA-based optical fiber sensor are measured in the 1500 to 1600 nm wavelength range. It is discovered that the shift of the wavelength in the SMF sensor is linearly proportional with the increase in the cDNA concentrations from 0.1 to 1.0 nM. The sensitivity of the sensor toward DNA is measured to be 1.2862 nm/nM and able to detect as low as 0.1 fM. The sensor indicates high specificity when only minimal shift is detected for non-cDNA testing. The developed sensor is able to distinguish between actual DNA of Leptospira serovars (Canicola and Copenhageni) against Clostridium difficile (control sample) at very low (femtomolar) target concentrations.

Keyword: DNA biosensor; Leptospira bacteria; Femtomolar concentrations; Infrared detection; Leptospirosis disease; Tapered optical fiber; Wavelength shif