Abstract

Heterodyne detection has been given much more flexibility of different kinds of the measurement purposes with suitable optical configuration and currently considered as an advantageous method of optical signal detection compared to other conventional detection techniques. In this thesis, design and implementation of an optical heterodyne detector based on ESM-12B photonic crystal fiber sensors have been attracting great interest because of their high sensitivity, and Fiber Brag Grating (FBG) has been presented. This system has been used to detect the wavelength shift over various ranges of applied temperatures, in this work utilized laser source in 1550 nm. According to the results show that the sensitivity of PCF sensor is notably increased with adding FBG to sensor, this comes from the fact that tunable wavelength has been ensured due to the existence of the FBG. The sensitivity of PCF sensor without FBG is -5.16 pm/°C. While, the accuracy has been noticed 0.006 nm for every 5 degrees Celsius at a temperature of 30°C 0 to 60°C, and a 0.024 nm at the temperature from 60°C to 70°C. The sensitivity with adding FBG is -9.43 pm/°C, and the accuracy has been recorded 0.03 nm at temperature from 30°C -50°C, and 0.01nm at temperature from 50°C -70°C.

The sensitivity of heterodyne detection is about -20.84 pm/°C, compared with homodyne detection at 3.06 pm/℃, the accuracy has been noticed 0.006 nm for every 5 degrees Celsius at a temperature of 30°C 0 to 60°C, and a 0.024 nm at the temperature from 60°C to 70°C. a slight shift to the shorter wavelengths has been linearly recorded when the temperature exposed from 30°C to 70°C.