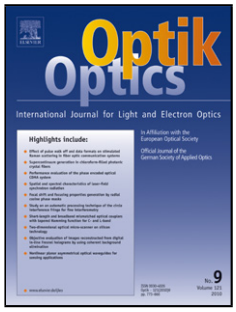

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Author: Yinggang Liu Wei Zhang Haiwei Fu Zhenan Jia Chengju Ma

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Temperature Dependency of Cladding-etched Fiber Bragg Grating Surrounded with Liquid

Yinggang Liu[a,*] , Wei Zhang[b], Haiwei Fu[a], Zhenan Jia[a], Chengju Ma[a]

[a]*Ministry of Education Key Laboratory on Photoelectric Oil-Gas Logging and Detecting, Xi'an Shiyou University, Xi'an, 710065, China*

[b] *School of Environmental and Municipal Engineering, Xi'an University of Architecture and Technology, Xi'an, 710055, China*

∗Corresponding author
E-mail address*: ygliu@xsyu.edu.cn*

Abstract: Through packaging a cladding-etched fiber Bragg grating (FBG) with different liquid, we investigate the temperature dependency of etched FBG surrounded with liquid. Research results indicate that, for the etched FBG with diameter of 11.8μm and the employed liquid with refractive index of 1.456, the Bragg wavelength and corresponding peak power are changing with the variation of ambient temperature nonlinearly. In different temperature ranges, the Bragg wavelength can shift to opposite directions with different temperature coefficient. All the characteristics are different from the temperature dependency of ordinary non-etched FBG and the etched FBG surrounded with distilled water. These characteristics of cladding-etched FBG depend on not only the refractive index and the thermo-optic coefficient of ambient liquid but also the remainder thickness of fiber-cladding. While all the factors are designed reasonably, the characteristics of ordinary FBG can be changed in accordance with the requirement, which can provide guides for the applications of etched FBG in temperature compensation, gas sensing, thermo-optic switches and other functional applications.

Key words: Fiber Bragg grating; Fiber optics sensor; Refractive index; Thermo-optic effect; Temperature

1 Introduction

With the development of functional applications of fiber Bragg grating (FBG), the etched FBGs have attracted increasing interest in refractive index sensing [*1-5*]. Some literatures about the theories and experiments have been reported [*6-9*], and demonstrated that the Bragg wavelength shift is sensitive to the variation of surrounding refractive index (SRI) [*7-13*]. However, the etched FBG surrounded with liquid is sensitive not only to SRI but also the temperature of ambient liquid. The two factors can effect the Bragg wavelength shift and even the transmission power of the etched FBG, so that researchers proposed some methods to distinguish temperature and SRI in etched-FBG-based sensing [10,*11*]. But in most researches, the influences of SRI and temperature are thought independent, and the Bragg wavelength shift with temperature or refractive index change are usually treated as linearity.

In fact, the refractive index of liquid can be effected by temperature change [*12,14*]. As ambient temperature changes, the thermo-optic effect and thermal expansion of fiber and even the thermo-optic effect of surrounding liquid have effects on the etched FBG corporately. Consequently, the final Bragg wavelength shift is not only dependent on the contribution of the thermo-optic effect of liquid, but also on the contributions of the thermo-