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Opinion

Hetero Core Arrangement of Optical Fibers as an Effective Tool for Different Sensing Applications

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Abstract

In this concise communication, the effectiveness of hetero-core arrangement is outlined. The criteria of hetero core arrangement are briefly highlighted, supplemented by brief appraisal of interrogation schemes. Apart from this, the sensing implementations are also appraised. Of late, there is a growing surge in the sensing as well as communication industry. With the advent of electronics as well as photonics, the sensing implementations have come a long way. Through integrated photonics, newer developments have been emerging every day, thereby outsmarting their counterparts in their own field. During the last two decades, the communications as well as sensing field have been widely using hetero-core arrangements. Owing to their considerable tunability a well as ease fabrication procedures, they are preferred to the conventional adoptions. Hetero core in general refers to dissimilar step index/graded index fiber cores or photonic crystal fibers aligned together for a specific purpose. For instance, we can cite about single mode multimode single mode fiber arrangement [1-4].

ISSN: 2640-9739

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Submission: July 05, 2019

Published: July 11, 2019

Volume 1 - Issue 5

How to cite this article: Biswas R. Hetero Core Arrangement of Optical Fibers as an Effective Tool for Different Sensing Applications. COJ Elec Communicat. 1(5). COJEC.000523.2019.
DOI: 10.31031/COJEC.2019.01.000523

Introduction

In the similar note, the alternative arrangement can also be reckoned. When we look at the propagation characteristics, the transmission characteristics get influenced drastically. It is widely known that light propagates by means of total internal reflection in optical fiber [3-5]. Again, the signal is chiefly conveyed by guided mode or core modes. However, if there is a small exposed region in the cladding of the fiber, there happens to be another entry of cladding modes/leaky modes. When we talk SMS arrangement, there is a lead in fiber and lead out fiber. The signal in the form of light enters through lead in fiber and modulated light intensity is received through lead out fiber. There is no hard and fast rule of applying single mode fiber as the lead in or lead out. Instead, multimode fibers can be effectively placed as the lead in/lead out fiber. When fibers of dissimilar cores are spliced together, there arises multimode interference (MMI). This precisely occurs from the interference of the light beams within the joints. This MMI leads to self-image process. Self-image signifies the reproduction of the input signal after traversing a certain length of the mid fiber in case of SMS. When we go for the alternative arrangement where multimode fibers are placed side by side, thereby sandwiching a single mode fiber in between [4-7]. As per reports, the power distribution within these aforementioned arrangements is a function of the mid-length of the fiber as well as core-diameter. Even, the refractive index also plays a pivotal role in sensing applications. When we modulate these features, there is a considerable fluctuation of transmittance. Simultaneously, by injecting analytes with different refractive indices, one can assess different physical variables in the form of pressure, humidity, temperature etc. Regarding assessment of physical variables, there are various approaches. However, the modulation of transmitted signal can be interrogated in two domains: wavelength interrogation and intensity interrogation. The former category is sensitive to minute change which manifests itself in the form of shifted wavelengths. On the contrary, the intensity fluctuations are assessed through voltage change, power change or current change. However, the former category is expensive while the latter one is inexpensive.

Although several adaptations have been reported till now regarding sensing applications, there are certain challenges that need special mention. Detection of couple of parameters through these adaptations (hetero-core arrangement) is another challenge. The sensitivity as well as limit of detection plays an important criterion for sensing approaches. While augmenting these two, complications arise from the fabrication of these hetero schemes. Hence, there is a need to synergistic fabrication procedure which will cater ease interrogation as well as inexpensiveness. It is believed that these hurdles may be overcome in near future with state-of-the-art fusion splicers and highly sensitive receivers.

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