Major Project
Report

Design and Modelling of Step-Index Optical Fibre for Generation of Slow-Light

Submitted in partial fulfilment of
the requirements for the award of the degree of

Master of Technology
in
Microwave and Optical Communication Engineering

Submitted by
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2K15/MOC/20

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Certificate

This is to certify that the Major project report entitled "Design and Modelling of Step-Index Optical Fibre for Generation of Slow-Light" is a bonafide work carried out by Mr. Utkarsh Nigam bearing Roll No. 2K15/MOC/20, a student of Delhi Technological University, in partial fulfilment of the requirements for the award of Degree in Master of Technology in Microwave and Optical Communication Engineering.

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Declaration

I hereby declare that all the information in this document has been obtained and presented in accordance with academic rules and ethical conduct. This report is my own, unaided work. I have fully cited and referenced all material and results that are not original to this work. It is being submitted for the degree of Master of Technology in Engineering at Delhi Technological University. It has not been submitted before for any degree or examination in any other university.

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Abstract

In the past decade, great research effort was inspired by the need to realise purely optical communication systems, so came the need and application of active optical functionalities. This thesis focuses on a numerical modelling for slow light generation based on stimulated Brillouin scattering for bismuth oxide step index fibre for single mode operation. We have selected a wave-length of 1550nm for our thesis. The approach to acquiring slow light in optical fibre is based on the phenomena of stimulated Brillouin scattering.

Slow light phenomenon is to drastically decrease the velocity of light as it travels through certain media. Slow light can be generated via various methods like stimulated Raman scattering (SRS), stimulated brillouin scattering (SBS), electromagnetically induced transparency (EIT), coherent population oscillation (CPO), etc but here we are focusing on stimulated brillouin scattering.

For the proposed optical fibre structure, we have obtained affective mode area and confinement loss. A time delay of 104.45 ns has been achieved for the maximum permissible pump power of 976 mW with the Brillouin gain of 90.38 dB and figure of merit of 45.29 at 500 mW pump power. It is observed that time delay can be tuned with input pump power and length of the proposed ridge waveguide. Such tunable features of the slow light can have potential applications in realization of an all-optical network. The proposed structure is analysed by the finite element method using software COMSOL Multiphysics and MATLAB.

Acknowledgment

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Finally, I would like to express my sincere thanks to my parents and friends who helped me directly or indirectly during this project work.

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1. **Utkarsh Nigam**, Than Singh Saini, Ajeet Kumar, "Numerical Modelling of Single Mode Step-Index Optical Fibre in Bismuth Oxide for Slow Light Generation Based on Stimulated Brillouin Scattering", Journal of Modern Optics, 2017. (Communicated)

Conference

1. **Utkarsh Nigam**, Than Singh Saini, Ajeet Kumar, "Design of Single mode Bismuth oxide fibre for generation of Slow light", in *13th International Conference on* Fibre Optics and Photonics, OSA Technical Digest (online) (Optical Society of America, 2016), paper Th3A.39. 4-8 December 2016, IIT Kanpur, Uttar Pradesh, India. doi.org/10.1364/PHOTONICS.2016.Th3A.39.