Simulation Gain in the Semiconductor Optical Amplifier Tension

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ABSTRACT:
The structure of an optical communication system similar to any other electrical connection system consists of several elements, including the transmitter (light source), medium (fiber optic) and receiver (optical detector) is. Standard single-mode fibers for data transmission at wavelengths normally used 33/1 micrometers and 55.1 micrometers. Optical fibers in the wavelength range of the losses are insignificant. Despite the low loss optical fibers for data transmission over long distances (more than 50 km), the need to strengthen our optical pulses again. Therefore, the optical amplifiers are required. Semiconductor optical amplifier polarization is sensitive to the structure used to relieve tension. The advantages of optical communication devices compared to other communication devices, such as bandwidth, low weight, low-loss optical fiber, flexibility, safety data sent against electromagnetic interference and inexpensive noted.

KEYWORDS: Semiconductor optical amplifier, polarization, TE gain, TM gain, Tensile-Strained, gain coefficients.

1. INTRODUCTION

Development of communication devices that need to transfer high volumes of data traffic caused a rapid increase in telecommunication networks and develop the capacity of transmission networks is inevitable. The optical communication devices due to potential data transfer uate attention. A study of the first semiconductor optical amplifier gallium arsenide structure dates back to the invention of the semiconductor laser. [1] - [4] to transmit data over long distances at different distances, we need to strengthen our signal to reach. Optical amplifiers are generally divided into two categories:

• fiber amplifiers for amplified optical pulses weakened, are embedded in the long-distance route. To build this type of fiber material such as erbium fiber is added as an extension to the central region [7].

• SOA semiconductor optical amplifier can be considered equivalent to a laser cavity in which the feedback has been very weak and Through the process of Stimulated Emission of input signal is amplified in the active region. The SOA structure of light entering the active region in order to strengthen an active waveguide and exits from the end of the waveguide. [8] The main purpose of using SOA to achieve high bit rate and integration capability (due to very small) is [9].

2. NECESSITY OF USING A TENSION STRUCTURE

Massive growth of data transfer has resulted in the development of transmission network capacities. The development of optical telecommunications networks play a major role. Data transfer by optical fiber due to losses in the middle distances need to be strengthened. To strengthen the high-speed, low power consumption, low noise and high gain of the semiconductor optical amplifier we use. TE or TM-polarized electromagnetic waves to invigorate passes of the amplifier. But gain more from TM polarization TE. To fix the problem with the stress and tension of the semiconductor optical amplifier is used. This approach will strengthen the TE and TM polarization is substantially closer together.

3. APPLICATIONS

Photonic semiconductor optical amplifier is a device that amplifies an optical signal under the appropriate operating conditions [12], [13]. The first investigation of the amplifier semiconductor laser was invented in 1960 after then ziedler in 1970 and 1980, Agrawal in 1987, Riley in 1991 and Connolly in 2000 to continue their studies [14] and [15]. The effects of non-linear semiconductor optical amplifier itself shows that in 1989, Agrawal to study effects of non-payment [16]. Nonlinear effects as an application of semiconductor optical amplifier can be used in the construction of all-optical gates [17] and [18]. Processing and optical data transmission, optical semiconductor amplifiers for high gain, low power consumption, high speed and simplify coupling (compared to electrical) are very important [19] - [23].

4. SIMULATION RESULTS

More commercial optical amplifiers are independent of polarization dependence. But some differences in the optical device measures TE, TM are reinforcement, that the dependence of semiconductor optical amplifier to create polarization signal. Including change of polarization can be converted to DVD multi-wavelength multiplexer and noted [8] and [24]. In practice, to achieve an amplifier insensitive to polarization must stress method used in the active layer. This approach also increases TE. The result of the simulation study in 2007 Conley Ignoring term losses (to remove the negative part of the graph) in Figure 1 [25].

$$gm_{TM,TE}(\hbar\omega)=\frac{Cg}{\hbar\omega}\sum_{b=LH,HH,SO}\int_0^{\infty}\int_0^{\pi}k^2\sin\theta\,|M_{TM,TE,b}(k,\theta)|^2 L(E_{CV,b}(k,\theta))[f_c(k)+f_{v,b}(k,\theta)-1]d\theta dk \qquad (1)$$

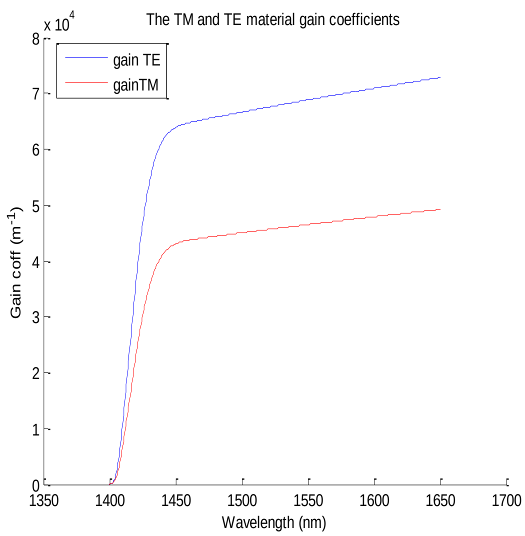

Fig. 1 The TE and TM in the semiconductor optical amplifier with a tension structure

5. CONCLUSION

One of the effects of polarization rotation effect is POlM. The first study on XPOlM in 1999 [26]. TE and TM polarization through the semiconductor optical amplifier, because of the difference in the effective refractive index confinement factor through the saturation of indirect interaction [27-29], the result of the interaction of phase shifts in the light emitted by the semiconductor optical amplifier. Researchers from the outcome of the spin polarization of the optical wavelength converters and optical systems achieved [27] and [30]. Other effects of nonlinear polarization rotation can be used to build all-optical sampling, optical buffers and optical comparators used [31] and [32]. Spin polarization in the semiconductor optical amplifier to achieve innovations in this amplifier was wide and deep. The most important of all-optical processors are fast and light gate [28].

6. NOMENCLATURE

abbreviation	Full
SOA	Simicoductro Optical Amplifier
TE	Transverse electric
TEM	Transverse electromagnetic
TM	Transverse magnetic
XPOlM	Cross-Polarization Modulation

REFERENCES

[1] P. Urquhart, **"Review of Rare Earth Doped Fibre Lasers and Amplifiers,"** pp. 385–407, 1988.

[2] Y. Aoki, "**Properties of Fiber Raman Amplifiers and Their Applicability to Digital Optical Communication Systems,"** *Light. Technol*, Vol. 6, No. 7, pp. 1225–1239, 1988.

[3] J. C. Simon, **"Semiconductor laser Amplifier for single mode fihcr communication systems,"** Vol. 4, pp. 52–63, 1983.

[4] O. N. ANDERS, **"Semiconductor Optical Amplifiers,"** *IEEE*, Vol. 80, pp. 375–382, Mar. 1992.

[5] E. Desurvire, **"Erbium-Doped Fibre Amplifiers: Principles and Applications,"** *John Wiley N. Y.*

[6] M. W.J, **"Erbium-Doped Glass for Amplifiers at 1550 nm,"** *IEEE J Light. Technol*, Vol. 9, pp. 234–250, 1991.

[7] Shoichi Sudo, **"Optical Fiber Amplifiers: Materials, Devices, and Applications"**, *Artech House Optoelectronics Library*, 1997.

[8] M. J Connelly, **"Semiconductor optical Amplifiers"**, *university of Limerick*, Ireland: Kluwer Academic, 2002.

[9] C. Politi, M. J. O'Mahony, and D. Klonidis, **"Dynamic behavior of wavelength converters based on FWM in SOAs,"** *IEEE J Quantum Electron.* Vol. 44, pp. 108–125, Feb. 2006.

[10] D. K.Cheng, **"Field and wave Electromagnetics"**, *16th ed. Univercity of tehran*, 2009.

[11] M. J. Connelly, **"Wide-Band Steady-State Numerical Model and Parameter Extraction of a Tensile-Strained Bulk Semiconductor Optical Amplifier,"** *IEEE J. QUANTUM Electron*., Vol. 43, pp. 47–56, Jan. 2007.

[12] S. D. Personick, **"Applications for quantum amplifiers in simple digital optical communication systems 8,"** *Bell Syst*, Vol. 52, pp. 117–133, 1973.

[13] G. Zeidler, **"Use of laser Amplifiers in glass fibre communication systems 7,"** *Siemens Forch*, pp. 227–234, 1973.

[14] Y. Yamamoto, **"Characteristics of AlGaAs Fabry-Perot cavity type laser amplifiers 9,"** *IEEE J Quantum Electron*, Vol. 16, pp. 1047–1052, 1980.

[15] J. C. Simon, **"GaInAsP Semiconductor laser Amplifiers for single-mode fibre communications 11,"** *IEEEOSA J Light. Technol*, Vol. 5, pp. 1286–1295, 1987.

[16] G. Agrawal, **"Self-Phase Modulation and Spectral Broadening of Optical Pulses in Semiconductor Laser Amplifiers,"** *lEEE*, Vol. 25, 1989.

[17] Kyoung Sun Choi, **"All-optical OR/NOR bi-functional logic gate by using cross-gain modulation in semiconductor optical,"** *Korean Phys. Soc*. Vol. 56, pp. 1093–1096, 2010.

[18] K. E. Stubkjaer, **"Semiconductor Optical Amplifier-Based All-Optical Gates for High-Speed Optical Processing**" *IEEE JOURNAL ON SELECTED TOPICS IN QUANTUM ELECTRONICS*, Vol. 6, Dec. 2000.

[19] S. D. Personick, **"Applications for quantum amplifiers in simple digital optical communication systems 1-8,"** *Bell Sysr Tech J*, Vol. 52, pp. 117–133, 1973.

[20] Y. Yamamoto, **"Characteristics of AlGaAs Fabry-Perot cavity type laser amplifiers 1-8,"** *IEEE J Quantum Electron*, Vol. QE-16, No. 10, pp. 1047–1052, 1980.

[21] Y. Yamamoto and T. Kimura, **"Coherent optical fiber transmission systems 1-8,"** I*EEE J Quantum Electron*, Vol. QE-17, pp. 897–905, 1981.

[22] H. A. Steinberg, **"The use of a laser amplifier in a laser communication system 1-8,"** *Proc IEEE*, Vol. 51, p. 943, 1963.

[23] G. Zeidler, D. Schicketanz, **"Use of laser amplifiers in a glass fiber communications system 1-8,"** *Siemens Forsch -U Entwickl*, pp. 227–234, 1973.

[24] D. T. Schaafsma and E.M. Bradley, **"Cross-gain modulation and frequency conversion crosstalk effects in 1550-nm gain-clamped semiconductor optical amplifiers,"** *IEEE Photon Technol Lett*, pp. 727–729, 1999.

[25] Katsuaki Magari, **"Polarization-Insensitive Optical Amplifier with Tensile-Strained-Barrier MQW Structure,"** *IEEE J. QUANTUM Electron.* Vol. 30, No. 3, Mar. 1994.

[26] H. Soto, D. Erasme, G. C. Guekos, et a1. **"5-Gb/s XOR Optical Gate Based on Cross-Polarization Modulation in Semiconductor Optical Amplifiers 13,"** *IEEE Photonics Technol. Lett.* Vol. 13, No. 4, pp. 335–337, 2001.

[27] H. Soto, C. A. Diaz, J. Topomondzo, **"All-Optical AND Gate Implementation Using Cross-Polarization Modulation in A Semiconductor Optical Amplifier 13,"** *IEEE Photonic Technol. Lett*. Vol. 14, No. 4, pp. 498–500, 2002.

[28] "**Nonlinear Polarization Rotation Characteristic Phenomenon in a Bulk Semiconductor Optical Amplifier 13,"** *Opt. Photonics J.* pp. 187–191, 2013.

[29] L. L. Yi, W.S. Hu, et al, **"All-Optical Reconfigurable Multi-Logic Gates Based on Nonlinear Polarization Rota-tion Effect in A Single SOA 13,"** *Chin. Opt. Lett.* Vol. 9, No. 3, pp. 1–4, 2011.

[30] P. Morin, J. Fatome, C. Finot, **"All-Optical Nonlinear Processing of Both Polarization State and Intensity Profile for 40 Gbit/s Regeneration Applications," Optics Express 13,"** Vol. 19, No. 18, pp. 17158–17166, 2011.

[31] M. Cheng, C. Q. Wu, et al, **"Cascaded Optical Buffer Based on Nonlinear Polarization Rotation in Semiconductor Optical Amplifiers 13,"** *Chin. Phys. Lett*. Vol. 25, No. 11, pp. 4026–4629, 2008.

[32] S. K. Garai, **"A Method of Developing Frequency En-coded Multi-Bit Optical Data Comparator Using Semiconductor Optical Amplifier 13,"** *Opt. Laser Technolo-Gy*, Vol. 43, No. 1, pp. 124–131, 2011.