

# Enhanced gain saturation model of non-linear semiconductor optical amplifiers

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IET OPTOELECTRONICS  
Volume: 12 Issue: 6 Pages: 263-268  
DOI: 10.1049/iet-opt.2018.5029  
Published: DEC 2018  
Document Type: Article  
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## Abstract

This study proposes an enhanced gain saturation model of non-linear semiconductor optical amplifiers (SOAs) by incorporating material-dependent gain compression factor. The rate equations are utilised with the extra gain compression term for Indium-Gallium-Arsenide material-based SOA to account for the steep relaxation oscillations behaviour of non-linear SOAs. The proposed gain saturation model is verified with experimental results that showed very good agreements with a mean square error of 0.094.


## Keywords

**Author Keywords:** gallium arsenide; indium compounds; semiconductor optical amplifiers; III-V semiconductors; optical saturation; enhanced gain saturation model; nonlinear semiconductor optical amplifiers; material-dependent gain compression factor; extra gain compression term; nonlinear SOAs; rate equations; steep relaxation oscillations; mean square error; InGaAs




**KeyWords Plus:** INGAASP LASERS

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## Funding

Funding Agency	Grant Number
Universiti Teknologi Malaysia	Q.J130000.21A2.04E06
Royal Society-Newton-Ungku Omar Advanced Fellowship	NA150463

[View funding text](#)

## Publisher

INST ENGINEERING TECHNOLOGY-IET, MICHAEL FARADAY HOUSE SIX HILLS WAY STEVENAGE, HERTFORD SG1 2AY, ENGLAND

## Categories / Classification

**Research Areas:** Engineering; Optics; Telecommunications  
**Web of Science Categories:** Engineering, Electrical & Electronic; Optics; Telecommunications

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1.	Title: [not available] By: Agrawal, G. P.; Dutta, N. K. Long-Wavelength Semiconductor Lasers Published: 1986 Publisher: Van Nostrand, New York	Times Cited: 820
2.	<b>GAIN NONLINEARITIES IN SEMICONDUCTOR-LASERS - THEORY AND APPLICATION TO DISTRIBUTED FEEDBACK LASERS</b> By: AGRAWAL, GP IEEE JOURNAL OF QUANTUM ELECTRONICS Volume: 23 Issue: 6 Pages: 860-868 Published: JUN 1987	Times Cited: 191
3.	<b>HIGH-FREQUENCY MODULATION OF 1.52 MU-M VAPOR-PHASE-TRANSPORTED INGAASP LASERS</b> By: BOWERS, JE; KOCH, TL; HEMENWAY, BR; et al. ELECTRONICS LETTERS Volume: 21 Issue: 7 Pages: 297-299 Published: 1985	Times Cited: 33
4.	<b>Coherent control in a semiconductor optical amplifier operating at room temperature</b> By: Capua, A.; Karni, O.; Eisenstein, G.; et al. NATURE COMMUNICATIONS Volume: 5 Article Number: 5025 Published: SEP 2014	Times Cited: 12
5.	Title: [not available] By: Connelly, M. J. Semiconductor optical amplifiers Published: 2007 Publisher: Springer Science & Business Media, Berlin Heidelberg	Times Cited: 9
6.	<b>Wideband semiconductor optical amplifier steady-state numerical model</b> By: Connelly, MJ IEEE JOURNAL OF QUANTUM ELECTRONICS Volume: 37 Issue: 3 Pages: 439-447 Published: MAR 2001	Times Cited: 230
7.	<b>Spectral gain and noise evaluation of SOA and SOA-based switch matrix</b> By: D'Alessandro, D; Giuliani, G; Donati, S IEE PROCEEDINGS-OPTOELECTRONICS Volume: 148 Issue: 3 Pages: 125-130 Published: JUN 2001	Times Cited: 10
8.	<b>DETAILED DYNAMIC-MODEL FOR SEMICONDUCTOR OPTICAL AMPLIFIERS AND THEIR CROSSTALK AND INTERMODULATION DISTORTION</b> By: DURHUUS, T; MIKKELSEN, B; STUBKJAER, KE JOURNAL OF LIGHTWAVE TECHNOLOGY Volume: 10 Issue: 8 Pages: 1056-1065 Published: AUG 1992	Times Cited: 112
9.	Title: [not available] By: Dutta, N. K.; Wang, Q. Semiconductor optical amplifiers Published: 2013 Publisher: World scientific, Singapore	Times Cited: 19
10.	<b>GAIN AND SATURATION IN SEMICONDUCTOR-LASERS</b> By: HUANG, J; CASPERSON, LW OPTICAL AND QUANTUM ELECTRONICS Volume: 25 Issue: 6 Pages: 369-390 Published: JUN 1993	Times Cited: 57
11.	<b>Compensation of carrier lifetime in double-pass semiconductor optical amplifiers</b> By: Kharraz, O. M.; Supa'at, A. S. M.; Mahdi, M. A. OPTICS COMMUNICATIONS Volume: 420 Pages: 116-121 Published: AUG 1 2018	Times Cited: 1
12.	<b>Polarization-independent ASE four-wave mixing in a fast semiconductor optical amplifier</b> By: Kharraz, Osayd M.; Mohammad, Abu Bakar B.; Forsyth, David I.; et al.	Times Cited: 5

OPTICS COMMUNICATIONS Volume: 355 Pages: 498-503 Published: NOV 15 2015

13. **STRONG INFLUENCE OF NONLINEAR GAIN ON SPECTRAL AND DYNAMIC CHARACTERISTICS OF INGAASP LASERS** Times Cited: **89**  
 By: MANNING, J; OLSHANSKY, R; FYE, DM; et al.  
 ELECTRONICS LETTERS Volume: 21 Issue: 11 Pages: 496-497 Published: 1985
14. **Semiconductor laser amplifiers for ultrafast all-optical signal processing** Times Cited: **153**  
 By: Manning, RJ; Ellis, AD; Poustie, AJ; et al.  
 JOURNAL OF THE OPTICAL SOCIETY OF AMERICA B-OPTICAL PHYSICS Volume: 14 Issue: 11 Pages: 3204-3216 Published: NOV 1997
15. **Gain, amplified spontaneous emission and noise figure of bulk InGaAs/InGaAsP/InP semiconductor optical amplifiers** Times Cited: **1**  
 By: Mazzucato, Simone; Carrere, Helene; Marie, Xavier; et al.  
 IET OPTOELECTRONICS Volume: 9 Issue: 2 Special Issue: SI Pages: 52-60 Published: APR 2015
16. **4-WAVE-MIXING IN TRAVELING-WAVE SEMICONDUCTOR AMPLIFIERS** Times Cited: **107**  
 By: MECOZZI, A; SCOTTI, S; DOTTAVI, A; et al.  
 IEEE JOURNAL OF QUANTUM ELECTRONICS Volume: 31 Issue: 4 Pages: 689-699 Published: APR 1995
17. **Fiber Laser** Times Cited: **2**  
 Edited by: Paul, MC  
 FIBER LASER Pages: 1-426 Published: 2016  
 Publisher: INTECHOPEN, JANEZA TRDINE9, RIJEKA, 51000, CROATIA
18. **Advantageous Effects of Gain Saturation in Semiconductor Optical Amplifier-Based Integrated Reflective Modulators** Times Cited: **4**  
 By: Talli, Giuseppe; Naughton, Alan; Porto, Stefano; et al.  
 JOURNAL OF LIGHTWAVE TECHNOLOGY Volume: 32 Issue: 3 Pages: 392-401 Published: FEB 1 2014
19. **Amplification of strong picosecond optical pulses in semiconductor optical amplifiers** Times Cited: **12**  
 By: Tang, JM; Shore, KA  
 IEE PROCEEDINGS-OPTOELECTRONICS Volume: 146 Issue: 1 Pages: 45-50 Published: FEB 1999
20. **CIRCUIT MODELING OF THE EFFECT OF DIFFUSION ON DAMPING IN A NARROW-STRIPE SEMICONDUCTOR-LASER** Times Cited: **179**  
 By: TUCKER, RS; POPE, DJ  
 IEEE JOURNAL OF QUANTUM ELECTRONICS Volume: 19 Issue: 7 Pages: 1179-1183 Published: 1983
21. **HIGH-FREQUENCY CHARACTERISTICS OF DIRECTLY MODULATED INGAASP RIDGE WAVE-GUIDE AND BURIED HETEROSTRUCTURE LASERS** Times Cited: **147**  
 By: TUCKER, RS; KAMINOW, IP  
 JOURNAL OF LIGHTWAVE TECHNOLOGY Volume: 2 Issue: 4 Pages: 385-393 Published: 1984

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