International Symposium on Electronics and Smart Devices (ISESD)

2017 International Symposium on Electronics and Smart Devices (ISESD)

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CERTIFICATE

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Ary Syahriar

as the Presenter

of the ISESD 2017

International Symposium on Electronics and Smart Devices

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General Chair

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Electron Devices Society
SSCS IEEE SSCS INDONESIA SECTION
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Message from General Chair

It is with both great pleasure and honor to welcome you all at the "2017 2nd International Symposium on Electronics and Smart Devices (ISESD 2017)", here in MICC, Alana Jogjakarta Hotel & Convention Center, Jogjakarta, Indonesia.

ISESD 2017 is our second international conference which is organized by the University Center of Excellence on Microelectronics Institut Teknologi Bandung (PME ITB). This is a venue for exchange of information among researchers, academicians, and professionals through presentation of their new research ideas, innovations and development results as well as discussion of possible cooperation among the conference participants. We also hope the fruitful discussion in this conference can fulfil the gap among academia, researchers, professionals and industries that may enhance the benefit of technology for human life.

We are very pleased to have scholars and participants coming across several countries over the world with different interest and expertise. The conference has been divided into 7 regular session topics, including 5 invited speakers, along with the additional 4 special sessions. A series of the state of the art plenary presentations will be presented by 5 international renowned experts.

It has been a real honor and privilege for us to serve as the General Chairs of the Conference. It is really our hope that you can find the conference inspiring, satisfying and enjoyable. We would like to thank to all keynote speakers, authors, and participants, and wish you have pleasant experience in Jogjakarta, Indonesia.

On behalf of the organizing committee, we would like to thank to ISESD International Advisory/Steering Committee members, and all the organizing committee members for their valuable time and contribution to the excellent arrangement of this conference. This conference will not be possible without the hard work of authors, reviewers, invited speakers, session chairs to make excellent technical program of this conference.

Finally, we would like to express our sincere gratitude to the School of Electrical Engineering and Informatics, Institut Teknologi Bandung (ITB), PME ITB. And also we are so grateful for the help from our colleagues and students of Universitas Islam Indonesia (UII) and technical sponsors for their excellent supports.

General Chair

Amy Hamidah Salman
Institut Teknologi Bandung, Indonesia

Message from Dean

School of Electrical Engineering and Informatics ITB

Dear participants, guests ladies and gentlemen. Welcome to Indonesia, welcome to Jogjakarta and welcome to the 2017 2nd IEEE International Symposium on Electronics and Smart Devices (ISESD 2017).

As the Dean of the School of Electrical Engineering and Informatics, Institut Teknologi Bandung (SEEI ITB), it is my great honor to be able to welcome you to this conference.

This international conference is one of several international conferences organized by the SEEI ITB in 2017. There are various conferences that are related to our research groups in the school/faculty. The ISESD 2017 is closely related to the Electronics Engineering research group.

The topics discussed in this conference covers various subjects, such as: Devices, Circuits, and Systems, VLSI, Communication Systems, Multimedia and Systems, Signal Processing, Internet of Things, and Smart Devices. The research and development in these fields are of great importance for now and in the future.

I appreciate the participation of attendees coming from many countries such as Japan, Taiwan, Turkey, Myanmar, Thailand, China, as well as participants from other countries including Indonesia.

In this occasion, I would like to give my sincerely gratitude to my colleague, Amy Hamidah Salman, as the General Chair of ISESD 2017 and his team for all their efforts in organizing this conference.

I hope that all of you will have a fruitful conference not only during presentation, discussion and technical sessions, but also during social and interpersonal communication from each other at the breaks, lunch, dinner and so on. I hope that the gathering of ISESD 2017 participants from various countries and cultures will bring a better understanding from each other and all of you will have enjoyable time here in Jogjakarta, Indonesia.

Dean of School of Electrical Engineering and Informatics

Dr. Ir. Jaka Sembiring, M. Eng.
Institut Teknologi Bandung, Indonesia

Message from Directorate General of Institutional Affair Ministry of Research, Technology, and Higher Education Republic of Indonesia

Dear participants, guests ladies and gentlemen. It is both a great pleasure and honor to welcome you all at the 2017 2nd IEEE International Symposium on Electronics and Smart Devices (ISESD 2017), here in the Alana Yogjakarta Hotel, Yogjakarta, Indonesia.

The Directorate General of Institutional Affairs currently puts a lot of efforts to increase the level of universities in Indonesia to a World Class University level. In correspond to these efforts, we hold a national center of excellence program. This program covers topics that are essential to the development of Indonesia. As a part of the National Center of Excellence (CoE), the University Center of Excellence on Microelectronics Institut Teknologi Bandung (PME ITB) is one research center that is supported by us to be the leader in microelectronics area. In the national level, besides microelectronics center, we have other 19 CoEs. This is a prestigious and very competitive program for all univesities in Indonesia.

As a national research center, we also give them a mandate to hold an international conference. We hope that by holding such an event, they can expose their research result, can communicate with many experts from all around the world, and can contribute to the society. We also hope that this conference will be a periodical conference that involves many experts and can be held in different places in Indonesia.

Finally, we would like to express our sincere gratitude to the Institut Teknologi Bandung and PME ITB as well as all the technical sponsors for their excellent supports in this conference.

We hope that the gathering of ISESD 2017 participants from various countries and cultures will bring a better understanding from each other and all of you will have enjoyable time here in Yogjakarta, Indonesia.

Directorate General of Institutional Affairs

Dr. Ir. Patdono Suwignjo, M.Eng.Sc.
Ministry of Research, Technology and Higher Education

Message from Chairmwoman of IEEE Indonesia Section

Dear Distinguished Guests, Colleagues, researchers, professionals, ladies and gentlemen.

Good morning, a prosperous, warm, and spirited greeting.

On behalf of IEEE Indonesia section, I would like to express my sincere gratitude and welcome you to ISESD 2017: 2017 2nd International Symposium on Electronics and Smart Devices.

ISESD 2017 is organized by University Center of Excellence on Microelectronics, Institut Teknologi Bandung, sponsored by IEEE Solid-State Circuits Society Indonesia Chapter and technically co sponsored by IEEE Indonesia section. The Conference is aimed to bring researchers, academicians, scientists, students, engineers and practitioners together to participate and present their latest research finding, developments and applications related to the various aspects of electronics and smart devices for bridging future technologies, indexed by well-known publishers, especially IEEE Digital Explore.

IEEE Indonesia Section has conducted many activities over 29 years in Indonesia. In terms of collaboration, IEEE Indonesia section has a good and mutual relationship with ICT organizations, Industries, Universities as well as the government in Indonesia. IEEE Indonesia Section has contributed in about 60 different International conferences annually, and I do hope in the near future some high quality conferences will be continued and strengthened, so the result will give more benefit and positive impact to the human being, especially to Indonesian people. Cooperation with international conferences is only one activity among many other activities in IEEE Indonesia section. We hope with many activities conducted by IEEE Indonesia Section, we can help our government to decrease the digital divide in Indonesia.

In this occasion, I would also like to say welcome to Yogyakarta, one of the famous destinations in Indonesia. Yogyakarta serves beautiful heritages, culture, mountain, beach and scenery with warm, polite and friendly people, a vibrant culture and lifestyle.

Finally, we do hope all of you will have enjoyable and valuable experience. During this 3 days conference, you may share your best knowledge in your area of research and professional activities.

Thank you.
Yogyakarta, 17 October 2017
IEEE Indonesia Section Chair,
Dr. Fitri Yuli Zulkifli, ST., MSc.

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Characteristic of L Band Erbium Doped Fiber Amplifier Under Forward Pumping Scheme

Ary Syahriar[1)], Anwar Mujadin[1)], Yanti Susanti[2)], Sasono Rahardjo[2)]
[1]Department of Electrical Engineering, University Al Azhar Indonesia, Jakarta, Indonesia
[2]Center for Information Technology and Communication, Agency for the Assessment and Application of Technology Indonesia

Abstract— **An experiment on L band EDFA is demonstrated by using forward single stage pump laser and EDFA structure. It uses an uncooled 980 nm pump laser with maximum optical output power of 250 mW. The L band EDFA used is 20 m in length with WDM 980/1550 nm couplers as pump power and signal combiner before entering into L band EDFA. The gain can achieve the value of 30 dB with gain variation within 1 dB in 30 nm from 1570-1610 nm spans of ITU grid wavelength. The lowest power starts at -20 dBm and can be amplified up to 3 dBm.**

Keywords— Optical communication; L band EDFA; WDM; laser 980 nm

I. INTRODUCTION

Erbium doped fiber amplifiers (EDFA) have become major key components for dense wavelength division multiplexing (DWDM) optical fiber communication systems. Using the fundamental properties of Er^{3+} in a glass host, it offers high gain, low noise and full compatibility with ITU standard for DWDM systems [1][2]. Lately long wavelength EDFA i.e. L band EDFA has attracted much intention and played a major role in extending optical bandwidth from previous C band structure. The extended wavelength use is from 1570-1610 nm having doubled bandwidth from 1530 - 1565 nm wavelength range with C and L band combination. Similar to those C band structures, L band can also be configured using single pump scheme but with more pumping power required to get similar gain as that in C band [3]. There was also a report that L band can be pumped using double laser pump with relatively efficient power pumping but with the expense of higher noise figure (NF) [4].

An L-band EDFA operates in a relatively low population inversion that a positive net gain is produced for L-band signals while energy absorption occurs at the conventional band. Therefore, pumping scheme has become major issues in L band EDFA to obtain high gain and low NF as well as pump power efficiency. There are a number of techniques to overcome these problems such as by using fiber bragg grating to suppress the growth of unwanted C-band amplified spontaneous emission noise. The most favorable method is by using double pump scheme with forward and backward laser pump with 980 nm and 1480 nm laser pump. In this paper we demonstrate a simple single pump structure with 980 nm pump laser and short L band EDFA [4]. The purpose is to get short L band length but with efficient pumping power to get good gain output at several pumping and signal power.

II. EXPERIMENTAL SETUP

The schematic diagram of single stage forward pumping L band EDFA is shown in Figure 1. It is a forward pumping scheme of EDFA on L band structure.

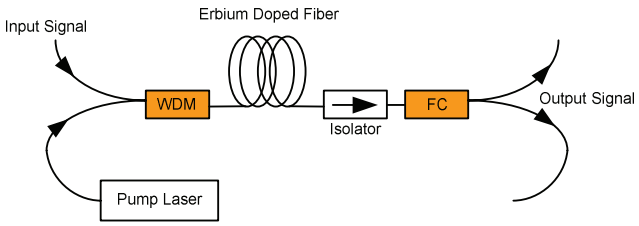

Figure 1. L band experimental setup

It consists of an uncooled diode laser with wavelength of 980 nm and maximum output power of 200 mW, a 980 nm/1550 nm WDM coupler which combines pump power and signal power from tunable laser source (TLS) and 13.5 m L band EDFA with mode field diameter of 5.5 ± 0.5 μm @ 1550 nm, peak absorption 25 ± 2 dB/m near 1530 nm and ≥ 7.0 dB/m near 980 nm, loss of ≤ 15.0 dB/km @ 1200 nm, mode cut-off at 920 ± 50 nm and core numerical aperture is 0.25 [5]. An isolator at the end of EDFA fiber provides a protection from back reflection to pump laser and to get enhance gain [6-8].

Based on the above design, the input L band signal and 980 nm input pump power enters 980/1550 nm WDM coupler into L band EDFA and amplified signal output from isolator. The TLS provides L-band input signal, the gain and NF of the amplifier is detected at the output by an optical spectrum analyzer (OSA). The L EDFA was characterized from 1570 to 1610 at ITU grid wavelength using TLS ANDO AQ4321 via an OSA ANDO AQ6317B. The performance parameter such as gain, NF and output power was taken at ITU wavelength standard with four different pump powers of 53.6 mW, 61.1 mW, 64.83 mW and 68.25 mW. A range of different input signal power ranging from -20 up to -5 dBm were used.

The design components used has been carefully chosen as to achieve good output gain with low power consumption. The main aim was to get better pumping scheme and reduce temperature to get good gain characteristics as well as reduce noises.

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III. RESULTS AND DISCUSSIONS

Prior to L band characterization, we firstly measure the optical power output from pump laser 980 nm with a range of current pumping. Figure 2 shows pump laser characteristics as a function of current. This demonstrates that the power output has simple linear shape as predicted.

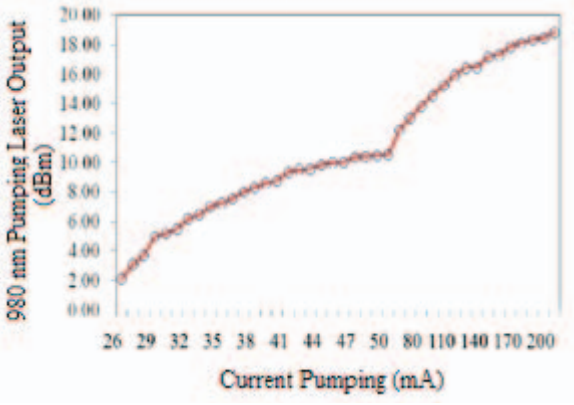
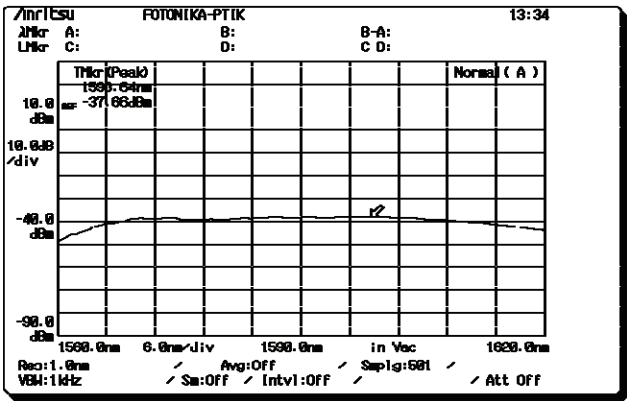


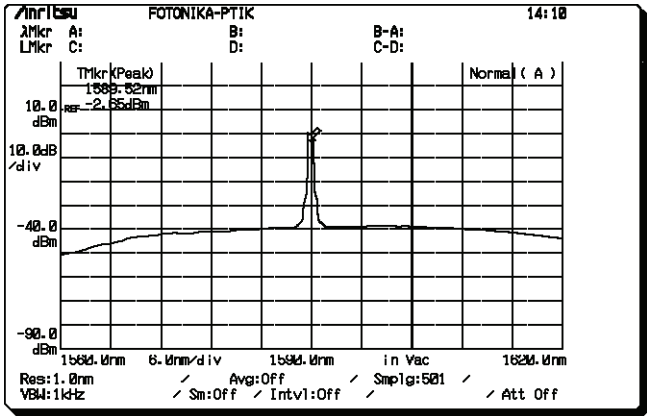
Figure 2. 980 nm pump laser characteristic

However, current input must be taken very carefully to protect laser from over current supply that may damage the laser. Furthermore, outside cooler needs to be provided to lessen the heat inside laser as current increase can damage the interferometers inside it.

To investigate the L band performances ASE spectrum is firstly measured at L band wavelength range. Figure 3a shows the output ASE spectrum of L band EDFA as a function of wavelength. It is clear that the ASE is flat enough at broad wavelength range that gives ability for further flat gain output signal. Pumping power has been choosen not to exceed saturated population inversion at around 12 dBm.



(a)



(b)

Figure 3. (a) ASE spectrum, (b) Amplification at λ=1589.52 nm

Figure 3b demonstrates signal amplification at wavelength of 1589.52 nm with signal input power of -20 dBm. The output signal becomes -2.65 dBm with gain of 17.35 dB. This result has proved small signal input can be amplified at shord L band EDFA and small pumping power for conservative population inversion.

To investigate signal input power after amplification at two different wavelength, the measurement of output signal as a function of input signal has been done at range of singnal input power. Laser pump power was fixed at output of 61.14 dBm and signal power was varied from -20 dBm to -5 dBm. Figure 4 shows power output as a function of signal input at two different wavelength i.e. 1580 nm and 1590 nm respectively. In this case signal power at both wavelength has different output power because of its different in cross section [6].

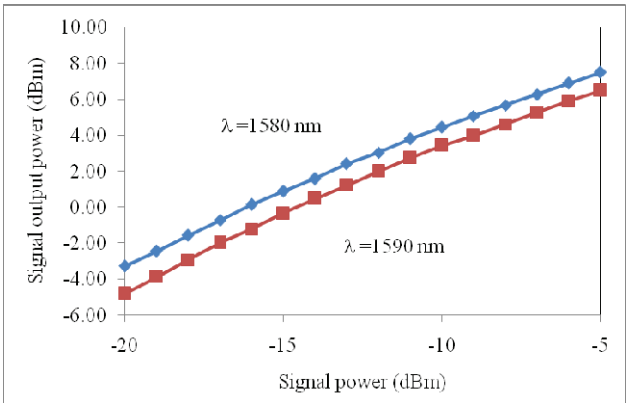


Figure 4. Signal output as a function of signal input at two different wavelength

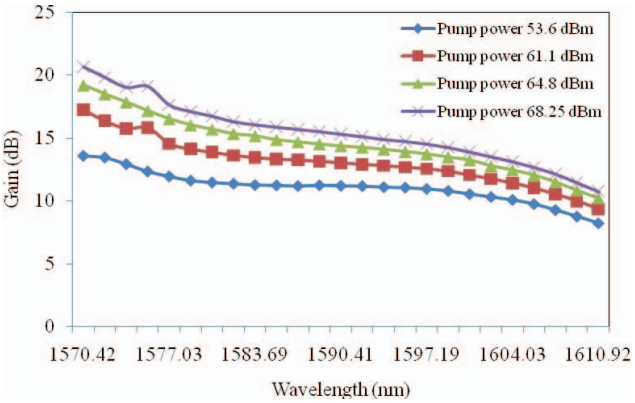


Figure 5. Gain as a function of different wavelength

Figure 5 shows gain as a function of wavelength for various pumping power. In comparison the gain can achieve the value of 20 dB at wavelength of 1570 nm and pumping power of 53.6 dBm. At the center wavelength gain flattening capability may be achieved around 23 nm wavelength span. For further flattening along L band wavelength fiber Bragg grating might be used to suppress gain fluctuation. However employing fiber Bragg grating might also reduce signal output at least 10% from original value.

IV. CONCLUSION

We demonstrated L band EDFA at wavelength range from 1570-1620 nm with variety of pumping scheme and input signal powers. The preliminary result shown in this paper can be used to further development of our L band system to achieve flat gain and low noise figure. The use of fiber Bragg grating to get gain flattening may also be useful for future development. We have demonstrated in this paper that small signal input and short length of L band EDFA can be used for small to medium gain requirement in the optical communication network especially for those ring metro application.

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