STUDY OF AMPLIFICATION ON ERBIUM DOPED FIBER AMPLIFIER

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INTRODUCTION

In optical fiber communication systems, signals propagate along the length of the fiber. These signals get attenuated due to absorption and scattering and broadening due to dispersion. After a certain length, the cumulative effect of attenuation and dispersion causes the signals to become too weak and indistinguishable to be reliable. Before this happens, the strength and shape of the signals must be restored. This can be done by an optical amplifier at an appropriate point along the length of the fiber.

There are two main classes of optical amplifier, namely, (i) semiconductor optical amplifiers, and (ii) fiber amplifiers. Semiconductor Optical Amplifiers need a high power from electrical pumping. However, the Erbium Doped Fiber Amplifier (EDFA) can be optically pumped which means can be operated with low power. Low power means low cost. Figure 1 shows the process of optical pumping. The EDFA is also not sensitive to polarization and less of non-linear phenomena, making it most suited optical amplifiers for multi channel bidirectional operation.

Erbium Doped Fiber Amplifier is the most common amplifier used in optical network systems because its simplicity, low cost, and optimum performance. The optimum performance of EDFA can be seen in high gain, low noise, and low insertion loss. The most important parameter of EDFA is its amplifier gain. This study will focus on the gain performance of the EDFA for various injection current pump laser at 980 nm and different length of the fiber.

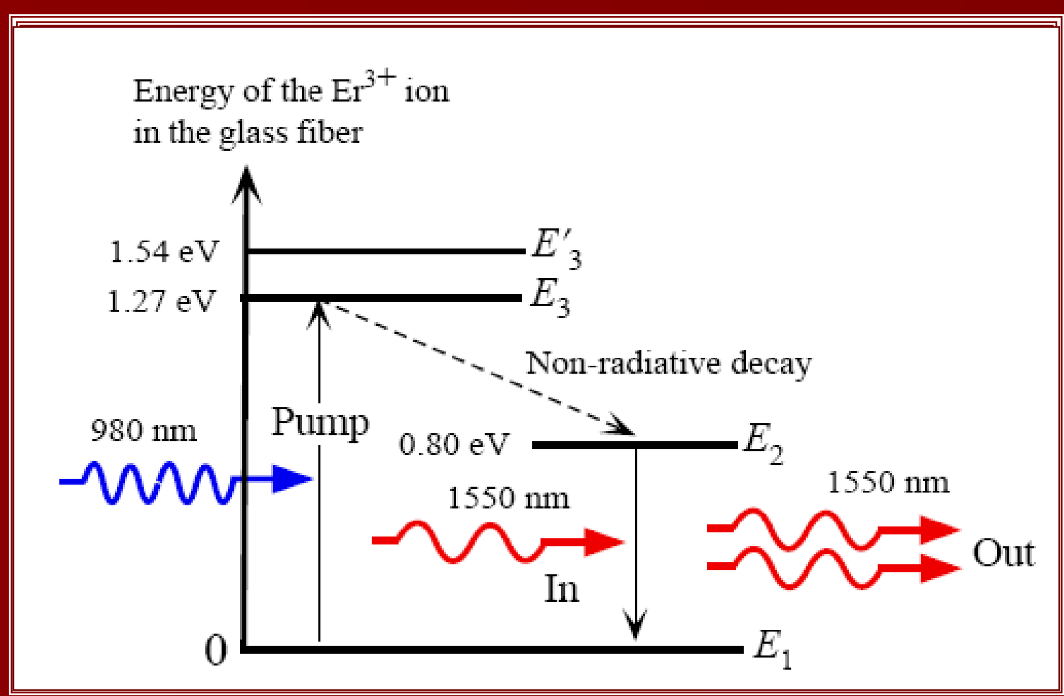

Figure 1: Optical pumping process of EDFA

METHODOLOGY

The fiber ends was prepared to optimize the transmission of light through the fiber. The buffer of the fiber was remove and the fiber end was cut perpendicularly. The fiber that has been cleaved was cleaned using isopropyl alcohol (C_3H_8O) to make sure there was no buffer left on the fiber. The fiber end was tested using optical spectrum analyzer and tunable source laser to detect any defect of the fiber and then select as a good sample.

The initial alignment was made using the laser beam from main source and pump laser as shown in Figure 2. It was aligned by using the XY-adjustment screw. The InGaAs photo detector was connected to the control unit and digital oscilloscope. The fiber was placed along from microscope objective to the photo detector. The square wave amplitude signal was traced in the Oscilloscope and then connected to personal computer to get real time signal output.

The injection current laser source was setup at (12 ± 1) mA to (20 ± 1) mA, by increment of 2 mA. The temperature was held constant at 25.0±0.1°C. The injection current pump laser varied from (0 ± 1) mA to (84 ± 1) mA when the injection current laser source was made constant. The change of signal strength was investigated using digital oscilloscope. The previous steps were repeated for various length of erbium doped fiber such as 0.3 m, 1 m and 2.5 m. Amplification was calculated by using equation (1).

$$G = 10\log P_o/P_i \qquad \ldots (1)$$

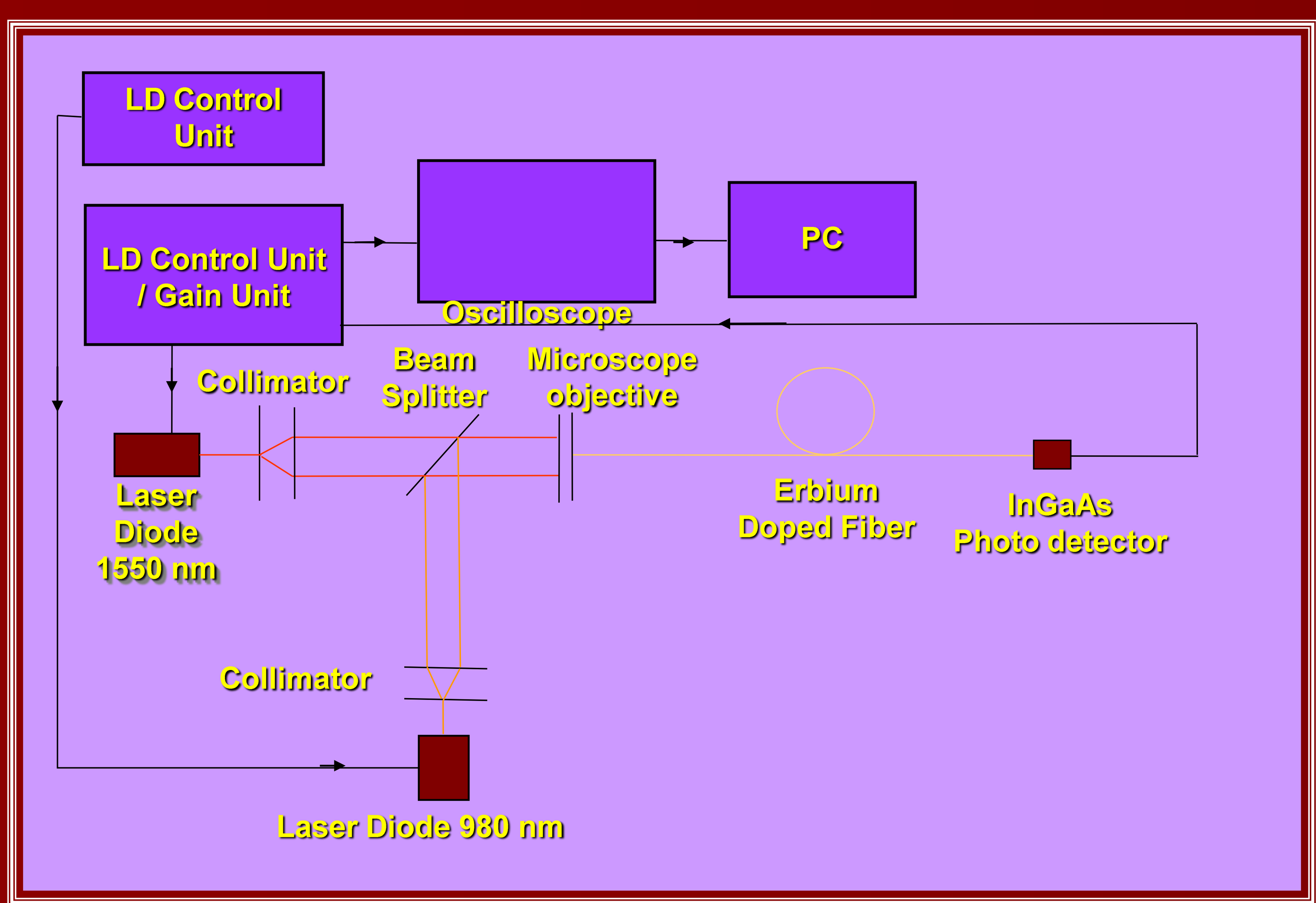

Figure 2: Experimental setup of EDFA

RESULTS AND DISCUSSION

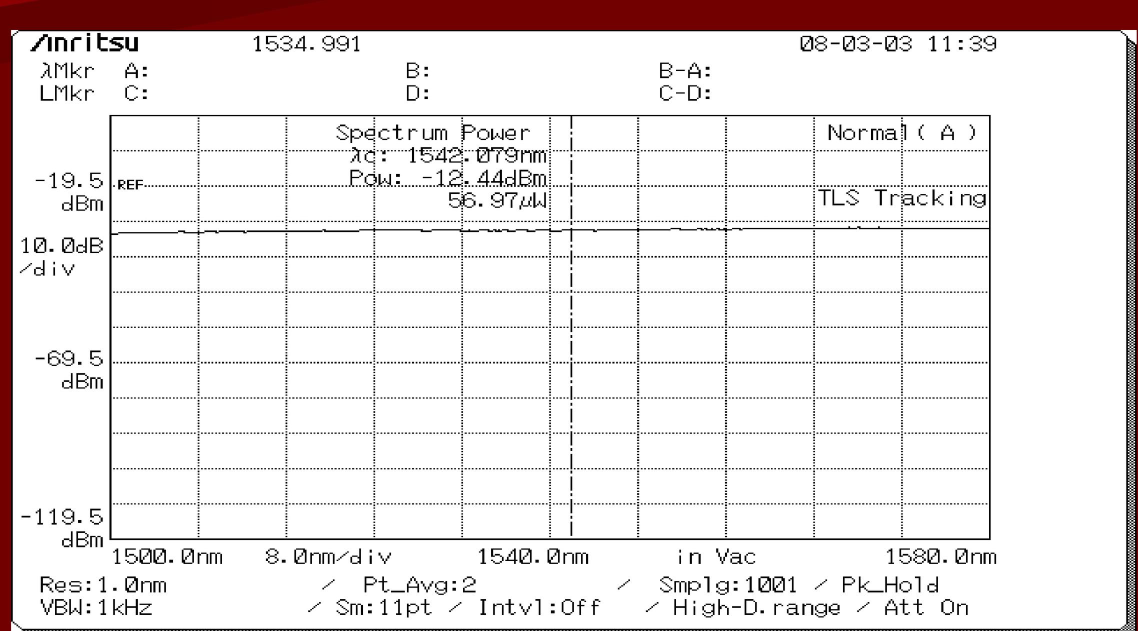

Figure 3:Optical Spectrum Analyzer shows the erbium doped fiber is already well prepared, so that the light can pass through the fiber without any defect.

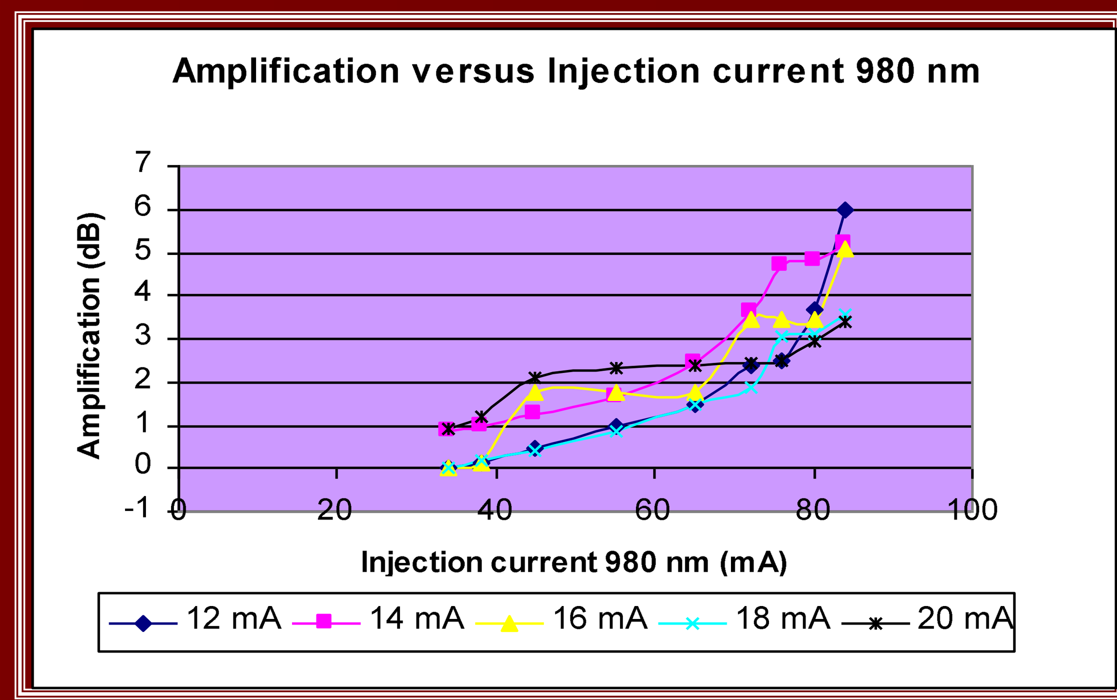

Figure 4: The Amplification versus injection current 980 nm for EDF length 0.3 m

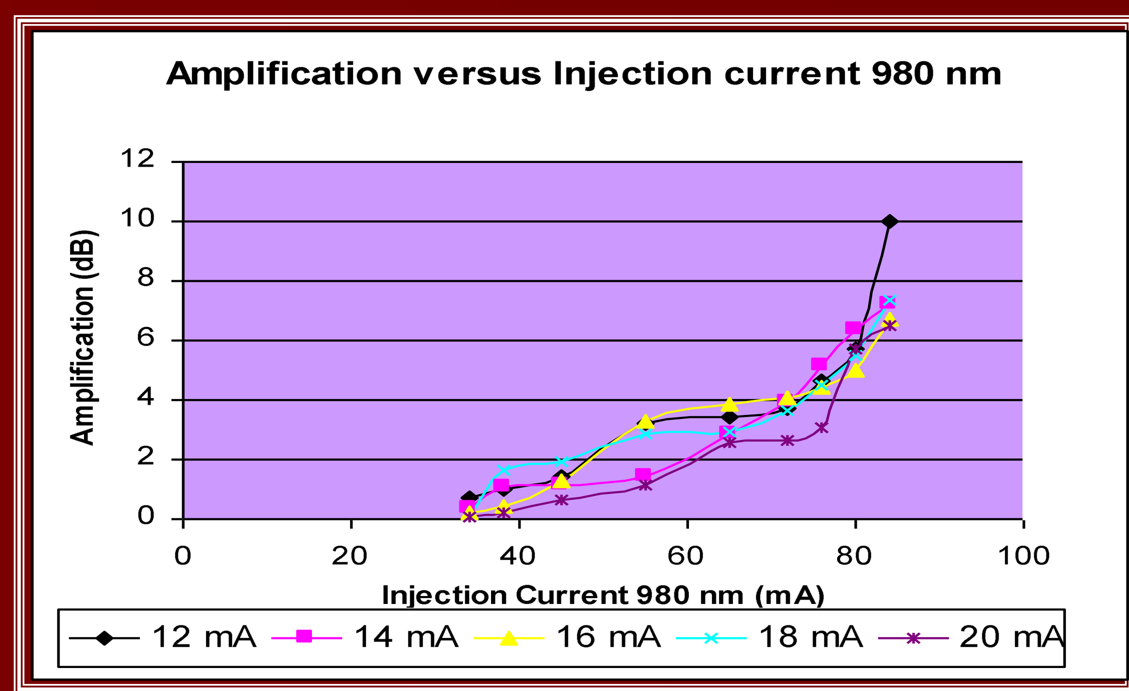

Figure 5: The Amplification versus injection current 980 nm for EDF length 1.0 m

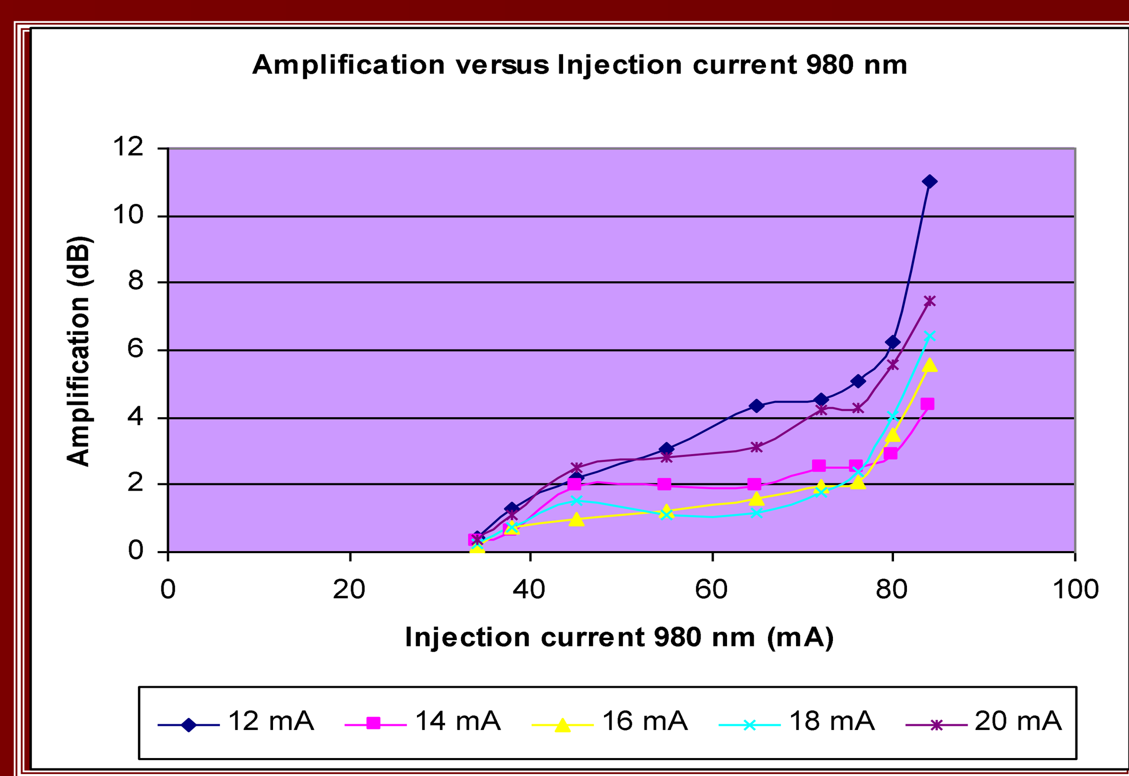

Figure 6: The Amplification versus injection current 980 nm for EDF length 2.5 m

Figures 4, 5 and 6 show the effect of injection current pump laser 980 nm will increase the amplification. This happens because the injection current pump laser produces more photons so that population inversion will also increase. The high population inversion obviously increases the amplification.

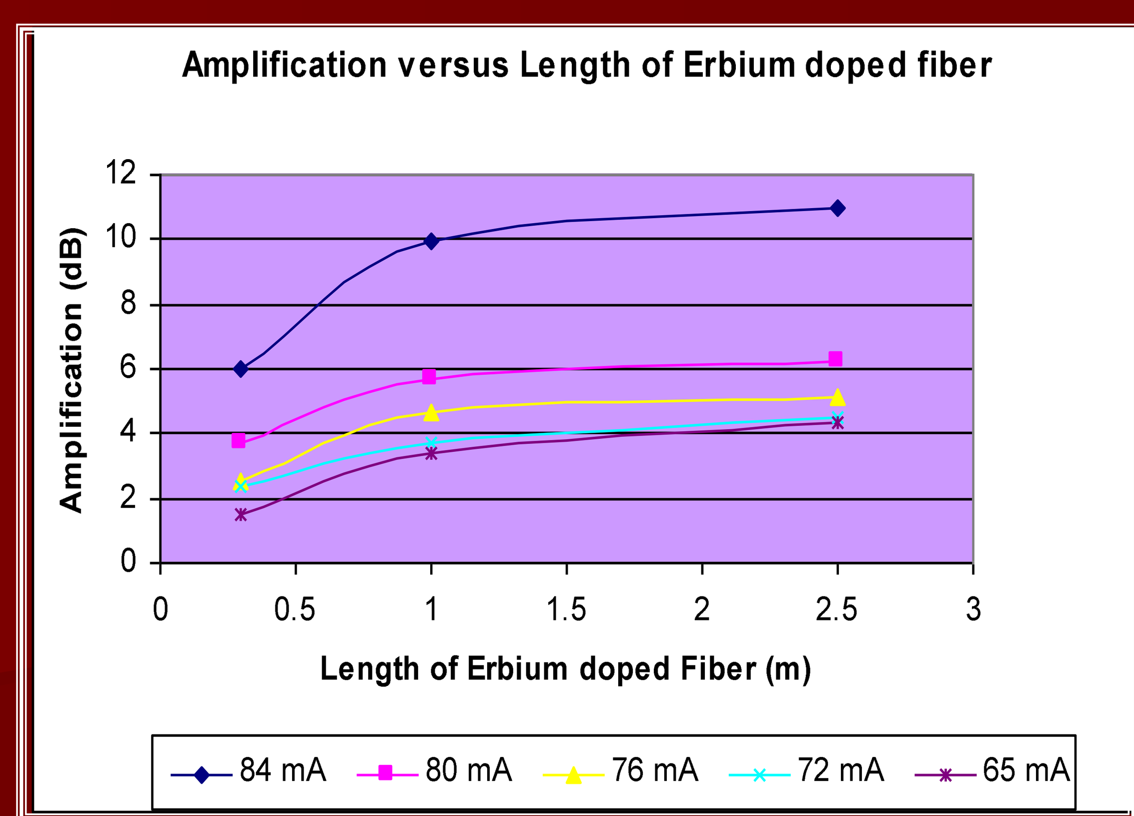

Figure 7: The amplification versus length of erbium doped fiber when the injection current of signal laser is (12 ± 1) mA and the injection current pump laser is varied.

CONCLUSIONS

- ✓ The results of experiments show that when the injection current pump laser is increased, the amplification also increases.
- ✓ The amplification of laser also increases when the length of erbium doped fiber is increased.
- ✓ The maximum gains of 6 dB, 9.9 dB and 11 dB are achieved for fiber lengths of 0.3 m, 1 m and 2.5 m respectively.
- ✓ The overall findings of the study indicate that amplification depends on injection current of the pump laser and the erbium doped fiber length.

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