스퍼터링 방법으로 휘토류를 첨가한 박막의 특성
Rare-Earth Doped Optical films made by sputtering methods

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Waveguides doped with rare-earth (RE) ions can be used as optically pumped active devices, as amplifiers, lasers, sensors, or switches. An outstanding example of a RE-doped waveguide device is the Er-doped fiber amplifier (EDFA). Demonstrated for the first time in 1986, it is now commercially available and widely used in experimental systems operating at 1.5 um wavelength. The number of researcher have undertaken research effort aiming at development of active devices based on other host waveguides than silica fibers, and also doped with other RE ions to amplify signals.

The main difficulty with integrated active devices, as compared to active fibers, is that a sufficiently large gain must be obtained in a device of a much shorter length. This requires about two orders of magnitude higher concentrations of RE ions at which cluster formation and strong ion-ion interactions tend to severely degrade the performance. A crucial issue for realising practical devices is to optimise host material composition and fabrication technology so that clustering of RE ions is minimised to an acceptable level. To be able to assess the quality of new materials and devices, I study new fabrication made by sputtering method for optical characterisation of rare-earth doped optical meterials, and for influence of clusters on the amplification properties.

In particular, Er-doped waveguides configured in silica glass on silicon substrate, which are the main technology to be investigated in the paper, are fabricated by sputtering.

Three different substrate materials were used : commercially available soda grass, $LiNbO_3$ wafer and Czochralski-grown (100) Si wafer. Thermal annealing in vacuum was performed on some samples using a standard tube furnace. Erbium concentration profiles as a function of depth were determined by EDAX. Photoluminescence(PL) spectroscopy was performed using an Ar+(488nm) laser as a pump source. Some measurements were performed in a liquid nitrogen and liquid He cooled cryostat. PL decay measurements were also perform.

The waveguide fabrication process involves in preparing a waveguide channel in each substrate by means of standard photolithograpy and reactive ion etching. The substrate is rectangular in shape with dimension about 2x2cm. Soda grass, $LiNbO_3$ wafer as well as Si wafer are successfully doped with optically active erbium. Each materials shows the characteristic of photoluminescence spectrum, and luminescence life times range from 2 to 25ms.

[참 고 문 헌]

1. Kuninori Hattori, Takeshi Kitagawa, Manabu Oguma, Hisaaki Okazaki, and Yasuji ohmori "Optical amplication in Er-doped P_2O_3-SiO_2 planar waveguide", J.Appl.Phys. 80(9), 1.November 1996