铒硅酸盐光学器件
Erbium Silicate Optical Device

Introduction

Er silicates have been attracting considerable attentions as Er based materials for small size and high optical gain waveguide amplifiers and emitters in silicon photonics integration, since Er silicates contain a higher Er^{3+} density of ~10^{22} cm^{-3}. However, it is expected that this material with such a high Er^{3+} concentrations will suffer from upconversion at high pump power.

An effective strategy to reduce this upconversion is to add Yttrium (Y) and Ytterbium (Yb) cations into the structure, where they substitute Er^{3+} ions in the silicate lattice and prevent neighboring Er^{3+} ions from causing upconversion due to similar ionic radius between Y(Yb) and Er. We focus on the optical device based on this promising material, including waveguide amplifier and electrically-pumped light source.

Materials characterization

Extraordinary infrared photoluminescence efficiency was found for Er_2SiO_5 film by optimizing the composition of Yb additions on SiO_2/Si substrates.

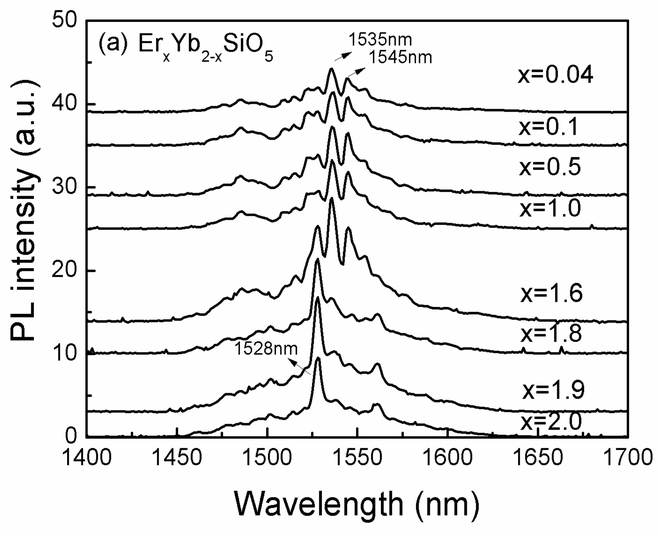

Fig. 1 PL spectra of $Er_xYb_{2-x}SiO_5$ (x=0-2) films on Si substrates at 654nm pump

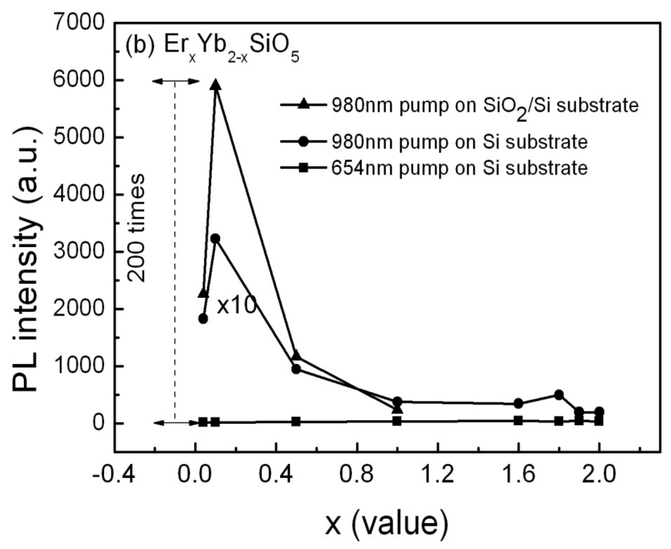

Fig. 2. 1.53μm integrated PL intensity of $Er_xYb_{2-x}SiO5$ films

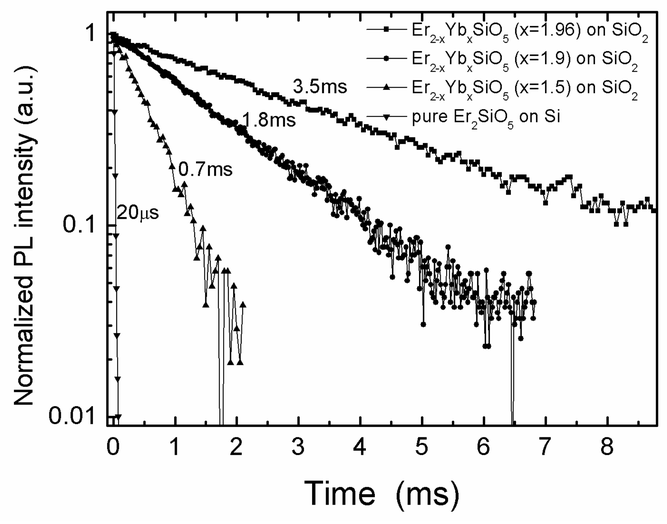

Fig. 3. Decay time of $Er_xY_{2-x}SiO_5$ films

Waveguide amplifier

A 5.5dB signal enhancement in a 7.8-mm-long waveguide pumped by 1480 laser.

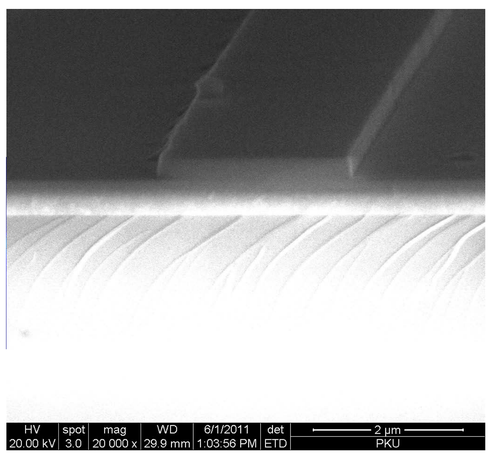

Fig. 4. SEM micrograph and fundamental TE-mode profile

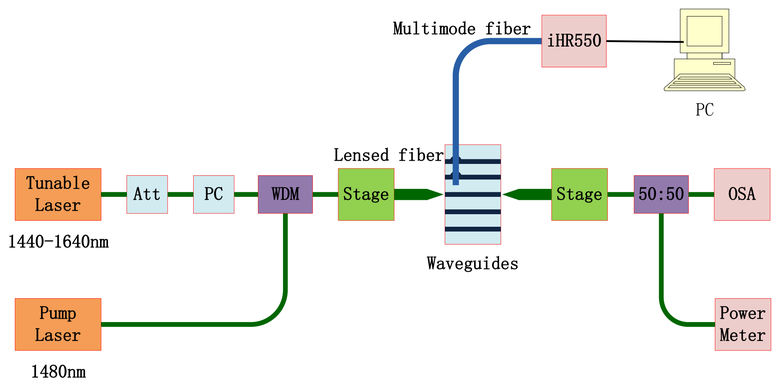

Fig. 5. Schematic measurement setup

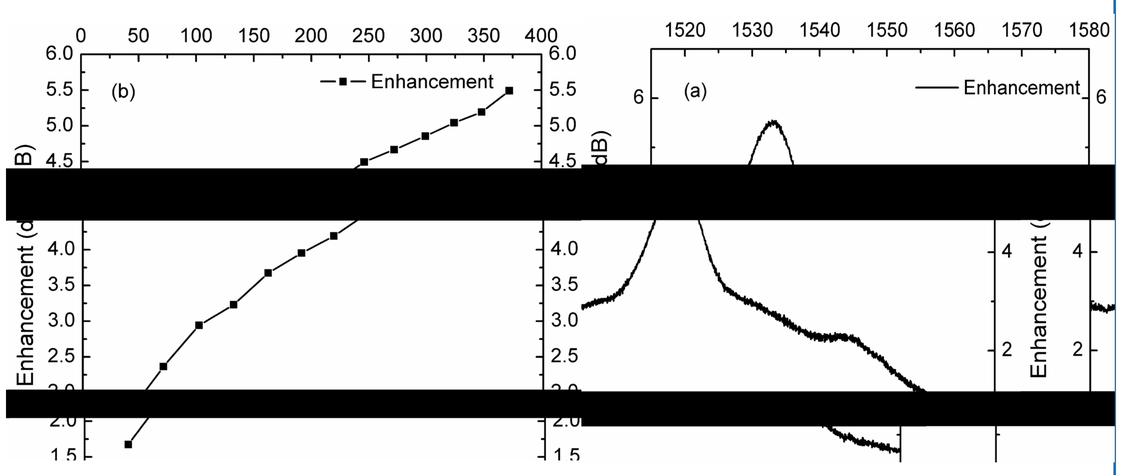

Fig. 6 (a) Measured signal enhancement for 1532.8nm signal light as a function of pump power (b) Signal enhancement in wavelength range of 1515-1580nm with fixed pump power of 372mW

Publication

X. J. Wang, B. Wang, R. M. Guo , B. Wang, H. Isshiki, T. Kimura, Z. Zhou. *Applied Physics Letters,* 98, 071903 (2011).
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