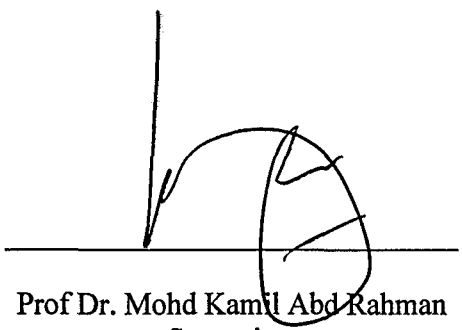
PREPARATION AND CHARACTERIZATION OF Er^{3+} DOPED SiO_2-ZrO_2 FILMS ON FUSED SILICA SUBSTRATES

NURUL FASIHAH BINTI MOHD SUHAIMI

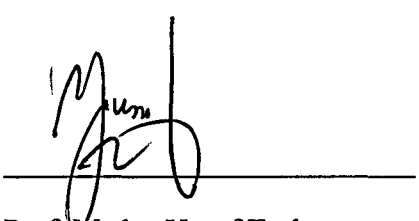
Final Year Project Report Submitted in
Partial Fulfilment of the Requirements for the
Degree of Bachelor of Science (Hons.) Physics
In the Faculty of Applied Science
Universiti Teknologi MARA

MAY 2011

This Final Year Project Report entitled "**Preparation And Characterization Of Er^{3+} Doped SiO_2-ZrO_2 Films On Fused Silica Substrates**" was submitted by Nurul Fasihah Binti Mohd Suhaimi, in partial fulfillment of the requirements for the Degree of Bachelor of Science (Hons.) Physics. In the Faculty of Applied Science and was approved by



Prof Dr. Mohd Kamil Abd Rahman
Supervisor
Bachelor of Science (Hons.) Physics
Faculty of Applied Science
Universiti Teknologi MARA
40450 Shah Alam
Selangor



Prof. Madya Yusof Teehran
Project Coordinator
Bachelor of Science (Hons.) Physics
Faculty of Applied Sciences
University Teknologi MARA
40450 Shah Alam
Selangor

Dr. Ab Malik Marwan Ali
Head of Programme
Bachelor of Science (Hons.) Physics
Faculty of Applied Science
Universiti Teknologi MARA
40450 Shah Alam
Selangor

Date: 25 MAY 2011

TABLE OF CONTENTS

ABSTRACT

PREPARATION AND CHARACTERIZATION OF Er^{3+} DOPED SiO_2-ZrO_2 FILMS ON FUSED SILICA SUBSTRATES

Er^{3+} doped glass-ceramics SiO_2:ZrO_2 films were prepared by sol-gel method using different SiO_2:ZrO_2 molar ratios (90:10, 80:20, 70:30, 60:40 and 50:50) with fixed 0.58 mole% Er^{3+}. There were five samples with 20 to 25 layers films were deposited on fused silica substrates by dip-coating technique. The effect of ZrO_2 on the photoluminescence properties was studied due to the exceptional properties of ZrO_2. Structural characterization was performed using X-ray diffraction and atomic force microscopy. Several optical properties, densification and surface morphology of these thin films were investigated as a function of SiO_2:ZrO_2 molar ratio. Optical properties such as refractive index, number of propagating modes and thickness of the thin films were measured at 632nm and TE mode of 1550nm by m-line technique. While, the transparency of the films was measured over the range 200 – 800nm with percentage of transmittance was almost 80%. The visible photoluminescence (PL) spectra of thin films were obtained upon at 514nm. Ratio of $50SiO_2$:$50ZrO_2$ achieve maximum intensity due to ZrO_2 properties which has low phonon energy ($470cm^{-1}$).

CHAPTER 1

INTRODUCTION

1.1 Background study

Erbium is a chemical element with atomic number 68 and used Er as a symbol. In periodic table, erbium is a rare-earth element belonging to the group of the lanthanides. It is a silvery-white rare earth metal that is malleable, soft yet stable in air and does not oxidize as fast as some other rare-earth metals.

Normally, erbium are assume as trivalent state (Er^{3+}) when embedded in a solid. It also has an electronic configuration [Xe]-$4f^{11}$ with incompletely filled 4f shell [16]. Radiative transitions between different energy levels are equality forbidden for free Er^{3+} ions. The 4f wave functions will be disturbed when erbium ion is incorporated in a solid material and it due to the two important effects. Firstly, the host material can introduced odd-parity character in the Er 4f wave functions and thus making radiative transition weakly allowed.