TEMPERATURE DEPENDENCY IN THE PREPARATION OF SILICON OXIDE (SiO_2) LAYER.

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ABSTRACT

In the fabrication of silicon based devices, oxidation process is one of the most important stages since the thickness of oxide layer is very accountable in determining the quality of the devices. Many publications have discussed the properties and applications of silicon (Si) which were investigated from many aspects. The oxidation temperature affects silicon thickness. The oxidation temperature is one of the parameter that can be controlled in order to produce certain required properties of the oxide layer mainly the oxide thickness. Previous researches have shown that the temperature of the oxidation furnace affects the oxide growth on silicon substrate. Therefore, several researchers already showed the oxidation at higher temperature will increase the thickness of silicon oxide (SiO). A series of silicon samples are prepared with different temperature.

In this project, the silicon oxide was prepared at elevated temperature but the other parameters such as oxidation time, oxygen flow rate, nitrogen flow rate, deposition pressure and crystal orientation are fixed. Two types of silicon wafer were used as substrate. They are n-type and p-type silicon of the same (1 0 0) orientation. The temperature of the oxidation furnace is made to be 500°C, 600°C, 700°C, 800°C, 900°C and the oxidation time for each temperature is done for 1 hour. The oxide thickness is formed to increase linearly with increase in furnace temperature. Oxidation on n-type silicon substrate is higher than that of p-type silicon substrate. The silicon oxide layer was successfully produced and the thickness of silicon samples had been measured. This study has provided useful information on the optimum parameters in preparing oxide layer especially for researchers who are using similar oxidation furnace.

CHAPTER 1

INTRODUCTION

1.1 Background

The chemical compound silicon dioxide, also known as silica is an oxide of silicon with a chemical formula of SiO_2 and has been known for its hardness since antiquity. Silica is most commonly found in nature as sand or quartz, as well as in the cell walls of diatoms. Silica is the most abundant mineral in the Earth's crust. Silicon dioxide (SiO_2) or silica is an electrical insulator and is used to electrically isolate various structure on a chip. In semiconductor technology, silicon oxide layers are mainly used as dielectrics. One of the reasons silicon is the most widely used in semiconductor is the ease with which a native oxide can be grown on it. Silicon dioxide forms whenever the silicon is exposed to oxygen. The most simple way to produce silicon oxide layers on silicon is the oxidation of silicon by oxygen. The oxidation of the silicon can be carried out wet or dry. In the dry process, the wafer is exposed to dry O_2, producing the reaction

$$Si + O_2 = SiO_2$$

Alternatively, in a wet oxidation process, the oxygen is introduced by water vapor, reacting via

$$Si + 2H_2O = SiO_2 + 2H_2$$

The function of a layer of silicon dioxide (SiO_2) on a chip is multipurpose. SiO_2 plays an important role in an integrated circuit (IC) technology because no other