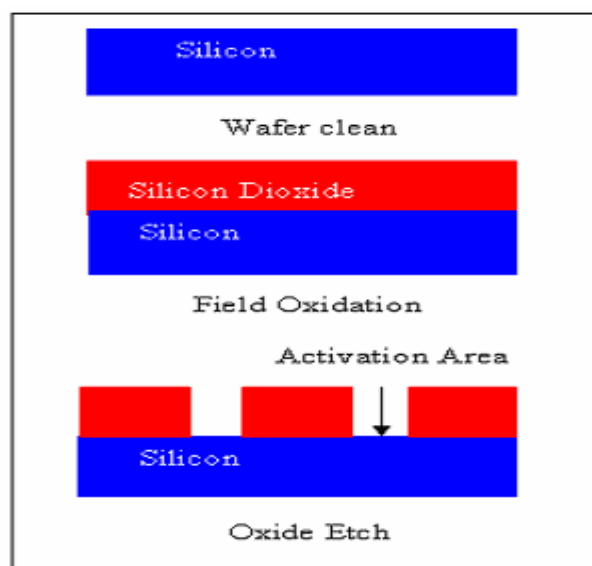


## CHAPTER 1

### INTRODUCTION

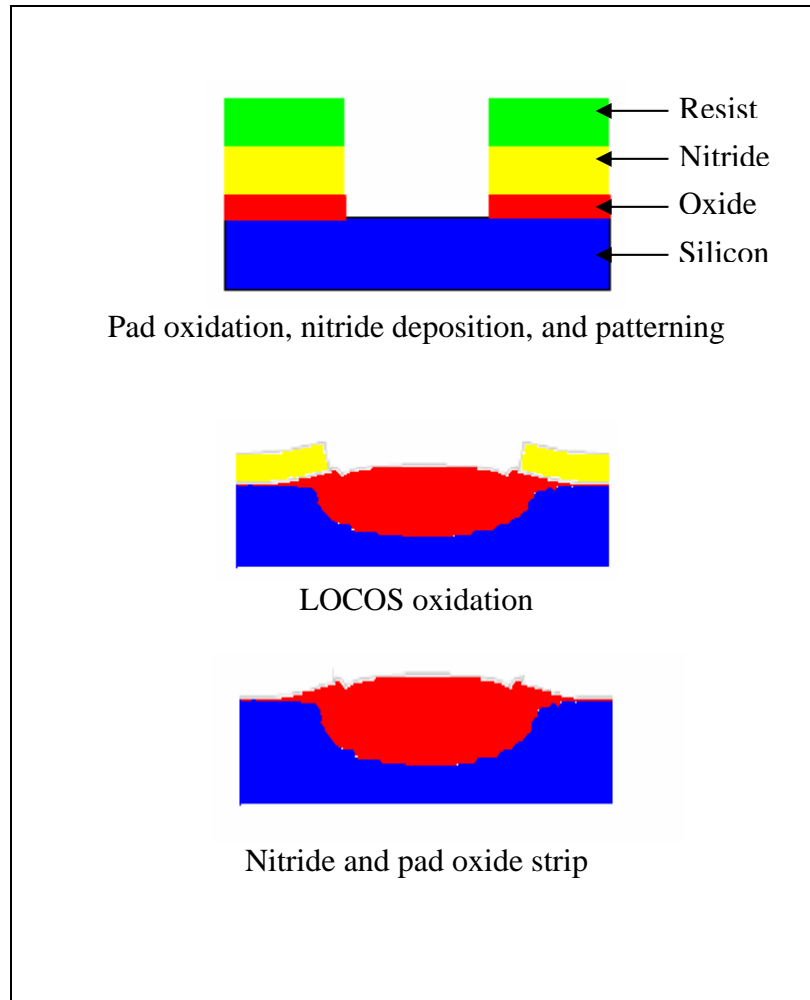
#### 1.1 PROJECT BACKGROUND

Device isolation is a limiting factor for fabricating high density VLSI circuits. The blanket field oxide and local oxidation are the two techniques used to isolate neighboring transistors in an IC chip. The blanket field oxide is the simplest isolation process, widely used in the early years of the semiconductor industry. By thermally growing a thick layer of silicon dioxide (5000 Å to 10,000 Å), patterning it via photolithography, and etching the oxide with hydrofluoric acid (HF), the activation areas can be opened for transistor making, as shown in Figure 1.0:



**Figure 1.0:** Blanket field oxide process

Local oxidation of silicon (LOCOS) has better isolation effect than the blanket field oxide. LOCOS process uses a thin layer of oxide (200 Å to 500 Å) as the pad layer to buffer the strong tensile stress of the plasma enhanced chemical vapor deposition (PECVD) nitride. After the nitride etches, photoresist strip, and wafer clean, a thick layer of oxide (3000 Å to 5000 Å) is grown on the area not covered by silicon nitride. The silicon nitride is much better barrier layer than the silicon oxide. Oxygen molecules cannot diffuse across the nitride layer, therefore the silicon underneath the nitride layer does not oxidize. On the area not covered by the nitride, oxygen molecules continuously diffuse across the silicon dioxide layer, where they react with silicon underneath to form more silicon dioxide. LOCOS formation process is illustrated in Figure 1.1.



**Figure 1.1:** Local oxidation process

Because oxygen diffusion inside silicon oxide is an isotropic process, oxygen also reaches silicon at the side. This causes the oxide growing underneath the nitride layer near the etched oxidation window to form the so-called bird's beak. The bird's beak takes a lot of real estate from the wafer surface, which is very undesirable. Another disadvantage of LOCOS is surface planarization due to the oxide-to-silicon surface step, caused by the oxide's growing characteristics.

The conventional local oxidation of silicon (LOCOS) process such as semi-recessed LOCOS, fully-recessed LOCOS, which uses a silicon nitride film as an oxidation mask and with a buffer oxide between the nitride and silicon, has been widely used in large-scale integrated circuits for its process simplicity. However, the continuing miniaturization of devices and their spacing are limited due to its inherent long bird's beak formation for maintaining a defect-free substrate. Several new variations of LOCOS isolation technology such as poly-buffered LOCOS, poly-buffered advanced LOCOS, SWAMI, SILO, and FUROX have been proposed to reduce the bird's beak. All involved complicated processing sequences.

## **1.2 AIM OF THE PROJECT**

The aim of this project is to produce the fully-recessed LOCOS and poly-buffered LOCOS. The project comprises several steps of process to produce the Poly-buffered locos and fully recessed LOCOS. In case of this project, the poly-buffered locos is actually one of the isolation technique that replacing the conventional process. The main target is to suppress the bird's beak that will be forming during the process. The area of this research is to study the effect of the poly-silicon layer and the composition of oxide that exist underneath of polysilicon and nitride layer.

### **1.3 OBJECTIVE**

- 1.3.1 Study of poly-buffered LOCOS and fully recessed LOCOS effect using 2 different thickness of pad oxide using Energy Dispersive X-ray (EDX).
- 1.3.2 Make a comparison between a poly buffered LOCOS and fully recessed LOCOS
- 1.3.3 Determined the composition of oxide that beneath under the polysilicon layer for poly buffered LOCOS and composition of oxide that beneath under nitride layer for fully recessed LOCOS after growth field oxide measured using Energy Dispersive X-ray (EDX).