CHARACTERIZATION OF TRENCH SCHOTTKY DIODE WITH TRENCH BOTTOM OXIDE (TBO) PROCESS

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ABSTRACT

A new Schottky diode structure namely as TBO Trench Schottky diode is proposed. Introduction of TBO process to the Trench Schottky diode has shown better device characteristics. In this study, the Trench Bottom Oxide (TBO) process was developed in order to increase reverse blocking voltage of Schottky diode. The process characterization on Trench Bottom Oxide (TBO) for Trench Schottky diode has been done to determine the *I-V* characteristic. Besides that, the device characterization analysis on Trench Schottky diode with and without TBO process is performed. As a result from the study, an improved reverse blocking voltage has been achieved. TBO layer in trench structure can reduce the electric field crowding at the corner of trench bottom then increased the breakdown voltage. From experimental results, breakdown voltage for Schottky diode structure with TBO is about -64.50V whereas the Schottky diode structure without TBO is around -60.50V. There is about 4V difference of breakdown voltage due to TBO effect. Another important factor that also determines the breakdown voltage of Schottky diode is gate oxide thickness. Thicker gate oxide demonstrating higher breakdown voltage.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

Schottky diode is formed when metal is brought in contact with lightly doped n-type semiconductor material. Schottky diode also known as hot carrier because it has majority carriers that are injected from the n-type to the metal (L. Poole 2011). When metal-semiconductor junction is formed the electron from the semiconductor will flow across the junction and fill the free energy state in the metal. This electron flows across the junction will create the depletion region between the metal and semiconductor. The difference in the energy level of work function between the metal and semiconductor is called as Schottky barrier (Hu 2009). When under forward bias which means metal connected to positive in an n-doped Schottky, there are many electrons with sufficient thermal energy to cross the barrier potential into the metal.

When Schottky diode in condition reverse biased or negative biased applied, the potential barrier for electrons becomes wide. Hence, there is small possibility that an electron will have enough thermal energy to cross the junction. The reverse leakage current will be in nanoampere range (B. Baliga, Advanced Power Rectifier Concepts 2009). The mode operation of Schottky diode is quite different with the PN junction because of the minority carriers and diffusion process is not involved (Sparkes, Semiconductor devices:How they work 1987).