SPICE MODEL FOR TIO_2 MEMRISTIVE SWITCHING

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ABSTRACT

This research project with due to some of practical issues affecting SPICE model, it focuses on the determination of switching mechanisms that were affects a SPICE model for the titanium dioxide memristor device. To have memristors as a feature in IC Design technology, the model for simulation needs to be fully understood for switching. Other than that, fabrication link with model needs to be fully established. The research project objectives to establish a link between model parameter based on actual measured data from in house fabrication samples. The taken data is used to establish the device parameter and implement to a simple memristor circuit in order to analyze circuit performance. In order to develop a spice model parameter for a memristor, there are two ways been used in this research project which collecting and analyze the data of sample comparison. The device simulation tested by using a simple digital circuit and compared with an existing spice model. Consequently, a clear link is established between actual fabrication and circuit performance. The device behavior can be linked in between the fabrication and circuit performance. This behavior is affecting the relationship for IV characteristic and the switching value.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter generalizes an overview of memristor. It explains briefly about project background and problems that occurs in this project. A few objectives based on the problem occur. Last but not least, the scope of work and thesis organization.

1.2 PROJECT BACKGROUND

More than 30 years, transistors have been following Moore's Law of integration. Nowadays, transistors are the major element to use in every electronic device. R.S Williams from HP labs uttered "It is time to stop shrinking" when they realized that a new passive element was discovered in 2008[1]. The memristor was named by Prof. Leon Chua in 1971 when he realized that there was no basic passive elements to describe relation between charge and magnetic flux since another passive element have their own relationship[2–5]

The first memristor in device form was realized by HP Labs Stanley Williams and his group in 2008. The device is composed of a very thin film of titanium dioxide (TiO_2). The thin film is sandwiched between two platinum (Pt) contacts and one side of TiO_2 is doped with oxygen vacancies. Initially there are two junctions; one junction is vaguely doped with oxygen vacancies, other undoped region. The oxygen vacancies are positively charged ion and make it conductive. The undoped region has high resistivity than the doped region[1], [4]. Thus it behaves as semiconductor.

Many research papers covered about the theoretical approaches, architecture, models, operation and potential applications of memristor. Memristor is contraction of "memory resistor" that has its own properties. It has been discovered that, the transistors become an issue in digital implementation where the dimension of the