2000년도 한국표면공학회 추계 학술발표회 논문 초록집

A STUDY ON THE ELECTRICAL PROPERTIES OF TIOxNy FILMS WITH CONTROLLED OXYGEN PARTIAL PRESSURE

Min J. Jung[a*], Kyung H. Nam[a], Yun M, Jung[a], Jin H. Boo[a], Jeon G. Han[a]
[a]Center for Advanced Plasma Surface Technology,
Sung Kyun Kwan University, 300 Chunchun-dong, Jangan-gu, Suwon, 440-746, Korea

1. Introduction

Titanium nitride has been widely used as the hard coating material for cutting and forming tools, and optical coating material for radiative heat loss through the window1, 2. Also in semiconductor industry, titanium nitride(TiN) layers are commonly used as diffusion barriers to prevent the conducting material(Cu or W) from diffusing into the silicon substrate through SiO2 layer3. It has been established that the unusual type of bonding is one important reason for their behavior. The bonding is mixed: covalent bonding of hybridized p and d electrons and metallic bonding with the d electrons of the metal4. The movement of the electrons is disturbed by imperfections and impurities in the crystal structure. This reduces the electrical conductivity5. On the contrary Titanium oxide is electrical insulator and has many unusual properties which make it suitable for a variety of thin film applications. Its excellent optical transmittance, high refractive, and chemical stability are attractive features for optical coatings.

On the other hand, the modification(TiOxNy) of titanium nitride films by the oxygen addition has been also tried for leveling their electric resistivity. Further, it has been reported that the titanium nitride containing oxygen is a promising

material as the functional materials6.
In this paper, we describe their electrical property, optical property as O2 flow rate.

2. Experiment

In this work, TiO_xN_y thin films were carried by a d.c magnetron sputtering method as a function of oxygen flow rate. The Changes of chemical states of constituent elements in the deposited films with the increase of oxygen content were examined by XPS analysis.

3. Results

As a result, the peak of Ti($2p^{3/2}$) shift to 457 to 459 eV. It is seen that the Ti2p peak of the TiNxOy films have two resolved peaks corresponding to the $Ti2p^{3/2}$ and $Ti2p^{1/2}$ photoelectron peaks with oxygen. The epitaxial orientation and microstructural characteristics of the films were analyzed by transmission electron microscopy(TEM). The major part of the sample is amorphous TiN_xO_y and small part is TiN(111) crystallity as seen by HRTEM image and micro-diffraction pattern. The electrical properties(resistivity) of TiO_xN_y thin films varied from about 10 ㎝ to 10^{12} ㎝ as oxygen partial pressure. Also, the results of optical properties exhibit the interval of TiN and TiO_2 values as increased oxygen flow rate. With using these electrical and optical properties, we expect that it will be utilized ESD(electric static discharge) protection of semiconductor chip tray and disply.