OVERVIEW ON MAGNETRON SPUTTERED TANTALUM OXYNITRIDE THIN FILMS – STRUCTURES AND PROPERTIES

D. Cristea[1], L. Cunha[2], A. Crișan[1], D. Munteanu[1]

[1]*Materials Science Department, Transilvania University of Brașov, ROMANIA*
daniel.cristea@unitbv.ro
[2]*Center of Physics, University of Minho, Campus de Gualtar, Braga, PORTUGAL*

Abstract: *This paper aims to present the results concerning the structural characterization and some of the properties of magnetron sputtered tantalum oxynitride thin films. Tantalum oxynitride thin films have been deposited by sputtering, using as reactive gas a mixture of fixed proportion (17:3) composed of N_2 and O_2. The main variable parameter during the deposition process has been the overall flow of the reactive gas mixture. A secondary variable parameter has been the polarization voltage (grounded – GND and -50V, respectively). Thus, two sets of samples (Series 1 - -50V and Series 2 – GND) with varying flows have been obtained. The structural characterization, evaluated by X-ray Diffraction, has shown that the films are, for low flows of reactive gas, crystalline in nature. The raising of the reactive gas flow leads to the formation of quasi-amorphous films. The exhibited properties were shown to be closely related to the structural evolution of the films.*

Keywords: *tantalum thin films, sputtering, structural evolution.*

1. Introduction

Tantalum oxynitride thin films can be considered to be multifunctional materials, due to their main advantage of tuning the oxygen/nitrogen ratio content, thus leading to a myriad of properties and applications: as optical coatings, electro chromatic coatings (limiting the transmission of light due to an applied current), protective coatings, biocompatible coatings, diffusion barriers, high dielectric constant materials, refractory sensors [1], semiconductors [2], resistive random access memory materials [3], etc. Furthermore, tantalum oxynitride films have the potential to be catalysts under visible light, to either treat waste waters or to release hydrogen from water as a novel source of energy [4-7].

Most of the properties that tantalum oxynitride films will exhibit can be partially inferred, because new properties can arise from the addition of both oxygen and nitrogen, by studying the extreme structures which can occur, namely tantalum oxides and tantalum nitrides. Tantalum oxides films can be obtained in a great number of stoichiometry variations, stable or metastable, and are studied due to their remarkable properties, such as: high dielectric constant, high refraction index, thermal and chemical stability, etc. Tantalum oxide films can be found in the microelectronics field, as antireflection coatings deposited on solar cells, in fiber optics, as an insulator for high permittivity devices [8], inside MOSFET devices (metal oxide semiconductor field effect transistor) [9]. Tantalum oxides can also be used as biocompatible materials due to their chemical stability [10], or as catalysts [11].

Transition metal nitrides are well known for their properties, such as: high hardness, mechanical resistance, thermal and chemical stability, and are used as wear resistant coatings on cutting tools, or abrasion resistant