Effect of the rapid thermal annealing on the structure and optical properties of TaOxNy thin films deposited by reactive magnetron sputtering

Fadi Zoubian\(^1\), Eric Tomasella\(^1\), Angelique Bousquet\(^1\), Joel Cellier\(^1\), Thierry Sauvage\(^2\)

\(^1\)Institut de Chimie de Clermont Ferrand, Aubiere, France \(^2\)CNRS/CEMHTI Site Cyclotron, Orleans, France

fadi.zoubian@univ-bpclermont.fr

Tantalum oxynitride thin films have won a great importance in the late years due to the wide variation of their properties by tuning the deposition parameters. They are considered as multifunctional material and are presented as promising candidate for several applications, such as electroluminescent devices, dielectric layers, diffusion barriers for copper metallization, decoration coatings and as graded antireflective coating due to the variation of their refractive index between 2.1 and 3.8.

The properties of TaOxNy films depend strongly on their elaboration method which affects not only the oxygen/nitrogen ratio in the films but also their structure and density.

TaOxNy thin films were deposited by radiofrequency reactive magnetron sputtering from a pure tantalum target with different argon-oxygen-nitrogen mixtures at a constant power of 250 W, and then a rapid thermal annealing (RTA) at 900°C under nitrogen atmosphere was performed. The composition of the TaOxNy films was investigated by Rutherford backscattering spectroscopy. X-ray diffraction was used to investigate the microstructure of the films. The optical band gap was determined by an indirect calculation using the transmittance measured by UV-visible spectroscopy.

Spectroscopic ellipsometry was used to determine the refractive index and the extinction coefficient of the films.

A deep study of the effects of the RTA on the structure and properties of TaOxNy thin films is presented in this work. We detected the transition from amorphous to crystalline structure with the formation of Ta3N5, TaON and Ta2O5 phases, accompanied with a little increase of the oxygen content in the films which leads to a decrease in the refractive index due to the decrease of film’s density.

Keywords
sputtering
tantalum
density
structure