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On the growth of TiOx coatings by reactive magnetron sputtering from metallic and ceramic targets: a joint modelling and experimental story

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This work reports the study of the growth mechanisms involved in TiO_x thin film deposition by magnetron sputtering. An Ar-O_2 plasma chemistry obtained by dual magnetron setup operating in DC mode is used. Growth from both metallic and $TiO_{1.8}$ targets are compared. Isotopic $^{18}O_2$ is used as reactive gas for all different configurations. The aim is to differentiate oxygen coming from ceramic targets and oxygen coming from the gas phase. Indeed, using ion beam analysis techniques such as Rutherford Backscattering Spectroscopy it is possible to precisely analyze Ti, ^{16}O and ^{18}O content of the samples. Other investigation techniques such as AFM, SEM … are also used to fully characterize deposited coatings. In order to study the effect of energetic ions bombardment of samples during deposition, 70° and normal incidence samples are compared. In addition to sample's characterization, Langmuir probe, energy-resolved mass spectrometry and energy flux probe are used to obtain plasma phase properties.
In a second part, simulations tools are used to predict both discharge and coating's properties. In order to simulate the complete plasma process, three different software are used. Each one is handling a defined step of the process (i) neutral particle motion, (ii) charged particle motion and (iii) film growth. We will discuss the comparison between simulation predictions and experimental investigations. Those two approaches allow us to achieve a better understanding on the growth of oxide layers by reactive magnetron sputtering and how plasma parameters influence coating properties.

Keywords
Reactive Magnetron Sputtering
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TiO2
film growth