Characterisation of oxidation resistance and crystallisation of sputtered films using in situ FTIR method

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Fourier transform infrared (FTIR) spectrometry is a powerful method to characterise the nature of bonds involved in inorganic thin films. This method is usually used at room temperature to study the evolution of materials after annealing treatments. In this presentation, the first results dedicated to the use of in situ FTIR during the crystallisation of titanium oxide films and the oxidation of chromium boride films will be presented. Firstly, thin titanium dioxide films were elaborated on fused silica, silicon and steel substrates by High Power Impulse Magnetron Sputtering (HiPIMS) by using negative unipolar pulses ($U = 385\, \text{V}; f = 50\, \text{Hz}; t = 1.5\%$). As deposited titania films were X-ray amorphous. The crystallisation of anatase and rutile phases was monitored by in-situ spectroscopy as well as X-ray diffraction. In addition, optical band-gap assessments were performed by in-situ UV-visible spectrometry. This method allowed us to make correlation between optical measurements and films microstructure. Secondly, chromium borides and boronitrides films were deposited by pulsed-DC magnetron on silicon and steel substrates from a CrB$_2$ target ($f = 50\, \text{kHz}, t = 25\%; I = 0.4\, \text{A}$). In-situ FTIR clearly evidenced the formation of boron oxide while this compound was not evidenced by X-ray diffraction. Addition of nitrogen into CrB$_2$-based films strongly increases their oxidation resistance.

Keywords
oxides
borides
thin films
FTIR
UV-visible