

PhD Thesis from 01/09/2018

Laboratory: Institut des Matériaux Jean Rouxel (IMN), Nantes

Title of the work: *Plasma assisted deposition of metal doped TiO₂ thin films on flexible substrates for transparent conducting and/or photocatalytic properties*

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Doctoral contract: 1 758 € brut / month

Context of the work

This PhD subject is conducted in the frame of an international collaborative project PATIO, founded by the French Research Agency (2018-2021). This project is carried out in collaboration between the Institute of Materials Jean Rouxel, IMN, in Nantes and the Luxembourg Institute of Science and Technology, LIST. Two PhD theses will be conducted, one at IMN and the other at LIST. The PhD student recruited at IMN (from 01/09/2018) will have the opportunity to spend short-term scientific missions (1 to 3 weeks) at the LIST.

Description

The PATIO project aims at studying the Plasma Enhanced Chemical Vapor Deposition (PECVD) of thin TiO₂ films doped with metal atoms (W, Nb) on flexible polymer substrates at low temperature (< 100°C). Doping of fully or partially crystallized TiO₂ thin films by aliovalent metallic cations is to be optimized in order to lead to transparent conducting and/or photocatalytic films in the visible range.

The chosen deposition process is a low pressure inductively coupled radiofrequency plasma created from two organometallic precursors mixed with oxygen. Recent studies have shown that this plasma process (using O₂/Titanium tetraisopropoxide, TiPT mixture) allows us to deposit crystalline TiO₂ thin films in the anatase phase with a high photocatalytic activity under UV exposure.

The study entails the three following axes: (i) to develop the low temperature plasma process allowing to prepare metal doped TiO₂ films (by addition of a second organometallic vapor to the O₂/TiPT plasma), (ii) to study the reactions in the plasma phase and the metal doped TiO₂ film growth mechanisms (in situ diagnostics : optical emission spectroscopy, mass spectroscopy and ellipsometry) and (iii) study of the film structure (X-Rays diffraction, X-rays photoelectron Spectroscopy (XPS), Raman scattering, FTIR spectrometry, Scanning (SEM), Transmission (TEM) and Atomic Force (AFM) Microscopies), electrical, optical and photocatalytic properties of metal doped TiO₂ thin films..

The challenge is to succeed to obtain crystallized metal doped TiO₂ thin films with transparent conducting properties and/or photocatalytic properties at a deposition temperature compatible with polymer flexible substrates (< 100°C). The strategy used therefore is to pulse the power coupled to the plasma and/or to bias the substrate.

The ultimate objective is the deposition on polymer foils in a semi industrial plasma roll to roll reactor which will be developed by the LIST on the basis of the results obtained in the research reactors at IMN and LIST.

Profile of applicants

Dynamic and motivated student. The applicant should have received education in Materials Science (Physics and Chemistry) or in Plasma Physics and Chemistry with an interest for experimental work. A profile of physicist or chemical physicist with a Master or Engineer degree in the field of materials or nanotechnology or plasma will be appreciated.

Conditions of applications

Before the 14th of May 2018, send by e-mail the following information:

- Copy of Masters 1 and 2 or equivalent
- Transcript of marks obtained in Master (especially master 2)
- Recommendation letter of a supervisor during in internship (M1 or M2) in research
- Detailed Curriculum Vitae
- Cover letter explaining the motivation for the PhD work