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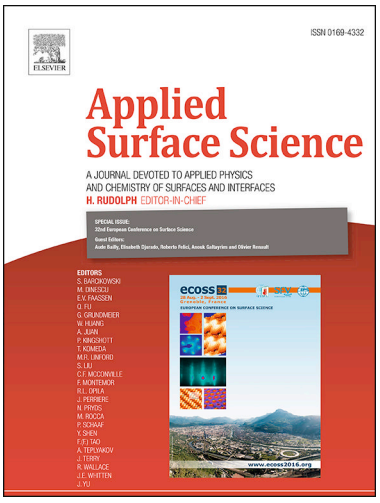

Full Length Article

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ALD growth of metal oxide on Carbon Nitride polymorphs

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Abstract

The implementation of a graphitic Carbon Nitride (g-C_3N_4) based organic-inorganic hybrid is discussed. The inorganic coating was deposited by Atomic Layer Deposition (ALD), allowing full control of thickness and homogeneity of deposited layer. We tested two different coating layers, alumina and titania, deposited by classical ALD, to discuss the effects of the precursor and gas reactivity on two Carbon Nitride samples with different surface terminations. Morphological (SEM, EDAX, TEM) and structural (Raman, XRD, XPS) measurements as well the study of decay kinetics upon optical excitation (time resolved luminescence) indicate that proper selection of organic substrate and reacting gas allows achieving homogenous covering by Metal oxide with classical ALD. In particular, a hybrid system g-C_3N_4/TiO_2 has been successfully achieved by using tetrakis(dimethylamido)titanium(IV) (TDMAT) as precursor.

Keywords: g-C3N4; Metal oxides; Atomic Layer Deposition; hybrid materials.

Introduction

In this paper, we discuss a proof of concept for the implementation of Atomic Layer Deposition (ALD) in the preparation of suitable organic-inorganic hybrids. These materials are gaining larger interest in many fields because of the possibility to obtain increased or new properties and performances as compared to separate components [1],[2],[3]. Indeed, advanced functionalities can be envisaged through a synergic cooperation or a fulfilling integration of organic and inorganic materials [4]. The main challenge is to achieve optimal control over the structure during the assembly process to guarantee the desired functions. ALD is a vapor phase technique applied to deposit thin films onto a substrate, allowing achieving highly conformal thin films over large areas or complex surface geometries [5]. Up to now, this technique was mainly applied for microelectronics applications and the reliability to achieve organic/inorganic hybrids is still poorly explored. Notably, ALD technique was successfully applied to fabricate hybrid organic/inorganic bulk heterojunction for photovoltaic devices. In particular ZnO film was deposited on poly(3-hexylthiophene (P3HT) to significantly enhance the inverted performance of organic photovoltaic cell.[6][7][8][9][10]