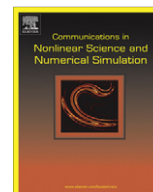




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New approach for consideration of adsorption/desorption data

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ABSTRACT

In this paper we proposed a new approach to modify the Langmuir model by considering nonlinear effects such as diffusion of water molecules in/out of an adsorbing film for humidity adsorption and desorption kinetics. The model was tested on the humidity adsorption and desorption data of a spin coated 50 nm thick Ruthenium polypridyl complex (Ru-PC K314) film, measured under relative humidity between 11% and 97% using by Quartz Crystal Microbalance (QCM) technique.

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1. Introduction

Quartz Crystal Microbalance (QCM) has been frequently used to investigate the kinetics of adsorption/desorption of adsorbate molecules [1,2] for monolayer films. It is a powerful technique to determine humidity sensing properties of materials before designing a sensor device during development stages. It is well known that the Langmuir model has been used successfully for monolayer films to analyze adsorption kinetics. A novel ceramic nanowires of TiO₂ and poly (2-acrylamido-2-methylpropane sulfonate) composite material films coated QCM was prepared as a low humidity sensor [3].

In the literature, the swelling behaviour of a series of hydrophilic random copolymer coatings in controlled humidity environments and in water has been investigated using QCM and spectroscopic ellipsometry by Chen et al. [4]. Thin films of polyaniline base, emeraldine base (EB), coating on the quartz crystal microbalance (QCM) electrode have been used as a sensitive layer for the detection of a number of primary aliphatic alcohols such as ethanol, methanol, 2-propanol and 1-propanol vapours [5]. A QCM coated with Nafion[®] film recast from Nafion[®](Ag) complex solution has been used to investigate the interaction between methanol, water and Nafion[®](Ag) and to determine simultaneously the concentration of methanol and water (relative humidity) [6].

In this work, we suggest a generalized Langmuir model to include nonlinear effect such as diffusion and condensation during humidity adsorption/desorption process. The suggested model was used to analyze the humidity adsorption and desorption QCM data of spin coated 50 nm Ruthenium polypridyl complex (Ru-PC K314) obtained under relative humidity between 11 % and 97 %.

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