EVOLUTION OF THIN FILM MORPHOLOGY - MODELING AND SIMULATIONS

By

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ABSTRACT

In the past few decades, thin film rough surfaces have received tremendous attention in the research community for their wide range of applications, including their use in the semiconductor industry, photonics, and potential use in energy solutions such as fuel and solar cells. As a result, it has become important to understand the various growth processes that affect physical properties of thin films to better control them for potential applications. To this end, considerable effort has been put forth to model the growth of thin films. In this work, the requisite background of thin film growth modeling is presented from a mathematically discrete and continuous point of view. These techniques are used to investigate the behavior of a number of interesting new growth phenomena. The growth of nanorods has become increasingly important because of their novel electrical, magnetic, and optical properties. A growth model is presented in this work that helps predict and control the shape of nanorods, which can have a significant effect on their physical properties. Model results indicate that the specific nature of the particle flux is very important to determining the final shape of a nanorod, and is in agreement with recent experimental results using oblique angle deposition. The growth and modeling of nodular defects, which is of interest in the fabrication of optical coatings, is discussed and shown to be governed by similar growth phenomena to those observed in nanorod formation. In addition, the physics behind complicated non-local growth effects such as shadowing and re-emission is presented in the context of a small world network, helping to elucidate the important characteristics of these growth effects.