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Deposition of Micro Crystalline Silicon Films Using Microwave Plasma Enhanced Chemical Vapor Deposition

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Abstract

A microwave plasma enhanced chemical vapor deposition (microwave PECVD) process has been investigated to deposit micro crystalline silicon films with a high growth rate from silane (SiH_4). A three-layer Bruggman-Effective-Medium-Approximation (BEMA) model was developed to describe the complex structure of the grown films. The model was confirmed by Raman and spectroscopic ellipsometry measurements. In addition the surface evolution was characterized by AFM (Atomic Force Microscopy) and spectroscopic ellipsometry data. Particular emphasis is given to the correlation between the structural film properties and the deposition parameters. Besides chemical reactions, it is shown that ion bombardment plays an important role for the crystallinity of the grown silicon films. In the presence of ions, hydrogen radicals are able to etch silicon, which significantly improves the crystallinity of the deposited films. If just radicals are present, the deposited films become amorphous.

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