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Continuum model of surface roughness evolution of a-Si:H films grown by low-temperature PECVD YEVGEN KRYUKOV, NIK PODRAZA, ROBERT COLLINS, JACQUES AMAR, University of Toledo — Using real-time spectroscopic ellipsometry the evolution of the surface roughness in a-Si:H thin-films grown on smooth c-Si/native oxide substrates by low-temperature plasma-enhanced chemical vapor deposition (PECVD) has been studied as a function of the H_2 dilution ratio $R = [H_2]/[SiH_4]$ with $15 \leq R \leq 60$. The best amorphous Si photovoltaic films correspond to a relatively high dilution ratio ($R \simeq 60$) such that the surface roughness is minimized but close to the amorphous-microcrystalline transition. After a brief period of nucleation of 3D islands, the roughness decreases but then eventually increases rapidly at large bulk layer thicknesses. Using a 3D continuum equation which includes a negative surface tension to take into account the destabilizing effects of short-range attraction and/or shadowing, as well as a smoothing term to take into account surface diffusion we have been able to obtain excellent agreement with experimental results for the evolution of the surface roughness. The dependence of our model parameters on the dilution ratio R is also discussed.

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