Fabrication of Si thin-film tandem solar cell on multi-surface textures of periodic honeycomb glass

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Multi-surfacetextures (MSTs) were developed for multi-junction Si thin-film solar cells; periodicmicroscale honeycomb textures and nanoscale textures were formed on a glasssubstrate and an aluminum-doped zinc oxide layer by wet etching using solutions based on hydrogen fluoride. The MST glassexhibited high transmittance, high haze ratio, and excellent light scatteringof both short- and long-wavelength light (average values of 80.8% and 59.8%) inthe 400–800 nm range. Using finite-difference time-domain simulation, wedesigned a hydrogenated amorphous and microcrystalline Si (a-Si:H/µc-Si:H)tandem cell with high short-circuit current density of ~12.5 mA/cm^2.To reduce plasma damage and surface stress on the ?c-Si:H layer during growth,we fabricated a a-Si:H/µc-Si:H tandem cell on the MST with a µc-Si:H layer thatwas only 1.5 µm thick and obtained a high light-conversion efficiency of 13.2%.It should be noted that the high short circuit current density and itsresulting high efficiency were due to the excellent light trapping at the MSTsand optimized AZO films. Maintaining a open circuit voltage and fill factor onMST and AZO film are based on the periodic honeycomb surface owing to thereduction of defects during the µc-Si:H growth. The developed MSTstructure and fabrication technique are expected to improve the performance ofvarious multi-junctioned Si thin-film solar cells.

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