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Silicon-based thin films deposited by reactive sputtering in antireflective system for silicon-based solar cells

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Abstract:

Silicon-based solar cells are still nowadays widely studied. Among them, bulk silicon cells as well as crystalline silicon thin films need an antireflective system to efficiently trap photons. For compatibility reasons, silicon based materials are the best candidate for such system.

In our laboratory, we explore for many years a large range of silicon-based material for the antireflective system dedicated to solar cells. For its versatility, we use reactive radiofrequency magnetron sputtering which allows us to deposit from an unique silicon target many materials: SiO_xN_y, SiC_xN_y:H, SiC_xO_y:H by controlling the injected gas mixture: Ar + O_2, N_2, CH_4…

The layer composition was investigated by Rutherford Backscattering Spectroscopy (RBS) using 2 MeV alpha particles. Chemical bonding was determined using Fourier Transform Infrared spectroscopy (FTIR). The variations of electron spin resonance parameters, the peak-to-peak line width Δ*H*pp, *g*-factor and the spin density, as a function of the film preparation were discussed on the basis of the complete physico-chemical characterization. To estimate the optical band gap and Urbach energy, transmission spectra were recorded using a double beam Perkin Elmer UV–visible spectrometer in the range of 200–1100 nm. The results were completed with phase modulation spectroscopic ellipsometry measurements using a UVISEL instrument in 260–955 nm (1.3 – 4.8 eV) spectral range to have access to refractive index and extinction coefficient. We show that the experimental procedure has a great influence on the structure and hence on the optical properties. And we demonstrate these materials can be integrated into multilayer or graded refractive index systems for improving photon trapping into photovoltaic solar cells.