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Optical Properties Analysis of SiNx Double Layer Anti Reflection Coating by PECVD

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The double-layer antireflection (DLAR) coatings have significant advantages over single-layer antireflection (SLAR) coatings. This is because they will be able to cover a broad range of the solar spectrum which would enhance the overall performance of solar cells. Moreover films deposited at high frequency are expected to show excellent and UV-stable passivation in the refractive index that we adopted.

In this work, we present a novel DLAR coating using SiNx:H thin films with refractive indices 1.9 and 2.3 as the top and bottom layers. This approach is cost effective when compared to earlier DLAR coatings with two different materials. SiNx:H films were deposited by Plasma enhanced chemical vapor deposition (PECVD) technique using SiH_4,NH_3 and N_2 gases with flow rates 20~80sccm, 200sccm and 85 sccm respectively. The RF power, plasma frequency and substrate temperature for the deposition were 300W, 13.56 MHz and 450℃, respectively. The optimum thickness and refractive indices values for DLAR coatings were estimated theoretically using Macleod simulation software as 82.24 nm for 1.9 and 68.58 nm for 2.3 respectively. Solar cells were fabricated with SLAR and DLAR coatings of SiNx:H films and compared the cell efficacy. SiNx:H films deposited at a substrate temperature of 450℃ and that at 300 W power showed best effective minority carrier lifetime around 50.8 μs. Average reflectance values of SLAR coatings with refractive indices 1.9, 2.05 and 2.3 were 10.1%, 9.66% and 9.33% respectively. In contrast, optimized DLAR coating showed a reflectance value as low as 8.98% in the wavelength range 300nm - 1100nm.