Production of Plasma-Enhanced SiO2 Films for Optimizing Photovoltaic Cells

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Solar energy is a promising power source with potential to play a critical role in decarbonizing the electric grid. It is essential that solar cells efficiently convert sunlight energy to electricity, and a low-cost means of achieving this is using anti-reflection coatings to ensure all incident light is absorbed. Chemical Vapor Deposition (CVD) is a common technique used to produce anti-reflection coatings for silicon solar cells, but it requires extremely high and unsafe temperatures. Plasma-Enhanced Chemical Vapor Deposition (PECVD) is an alternative method utilizing plasma in replacement of extreme heat. Silicon dioxide (SiO2) thin films were used due to their high light transmittance and quality dielectric properties. This study sought to develop a porous SiO2 recipe by altering deposition parameters to create an anti-reflection coating for photovoltaic cells. Thirty-nine porous SiO2 films were deposited with altering gas flow, temperature, pressure, and RF power. Optical measurements including refractive index (RI) and thickness were measured using Filmetric reflection spectroscopy and ellipsometry. Ideal deposition parameters were calculated to be 30 sccm SiH4 flow, 800 sccm N2O flow, 900 mTorr pressure, 450 Watt RF power, and 40°C. These parameters decreased the RI significantly to a value of 1.3200. This optimal recipe was deposited onto a glass slide to replicate solar properties, and the transmittance was measured under three wavelengths (630 nm, 450 nm, and 530 nm). A single and double-layer coating was placed on the glass slide, and quantities were compared. The recipe created was able to increase transmittance by an average of 7.3%, 4.8%, and 5.1%, and this technique can be applied for future anti-reflectance coatings for photovoltaic applications.

Awards Won:
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