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Optimized ultra-thin tunnel oxide layer characteristics by PECVD using N_2O plasma growth for high efficiency n-type Si solar cell

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Reducing surface recombination is a critical factor for high efficiency silicon solar cells. The passivation process is for reducing dangling bonds which are carrier. Tunnel oxide layer is one of main issues to achieve a good passivation between silicon wafer and emitter layer. Many research use wet-chemical oxidation or thermally grown which the highest conversion efficiencies have been reported so far. In this study, we deposit ultra-thin tunnel oxide layer by PECVD (Plasma Enhanced Chemical Vapor Deposition) using N_2O plasma. Both side deposit tunnel oxide layer in different RF-power and phosphorus doped a-Si:H layer. After deposit, samples are annealed at 850°C for 1 hour in N_2 gas atmosphere. After annealing, samples are measured lifetime and implied Voc (iVoc) by QSSPC (Quasi-Steady-State Photo Conductance). After measure, samples are annealed at 400°C for 30 minute in Ar/H_2 gas atmosphere and then measure again lifetime and implied VOC. The lifetime is increase after all process also implied VOC. The highest results are lifetime 762 μ s, implied Voc 733 mV at RF-power 200 W. The results of C-V measurement shows that Dit is increase when RF-power increase. Using this optimized tunnel oxide layer is attributed to increase iVoc. As a consequence, the cell efficiency is increased such as tunnel mechanism based solar cell application.

Keywords: Tunnel oxide, passivation, PECVD, Implied Voc

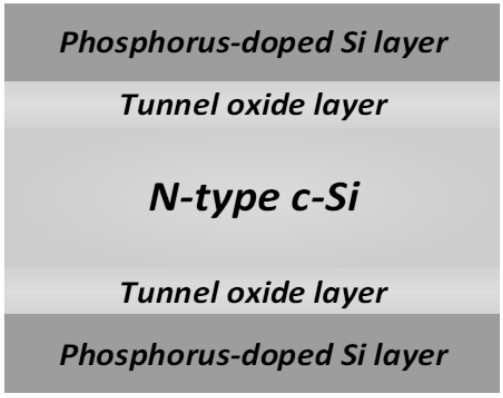

Figure 1. Sample structure

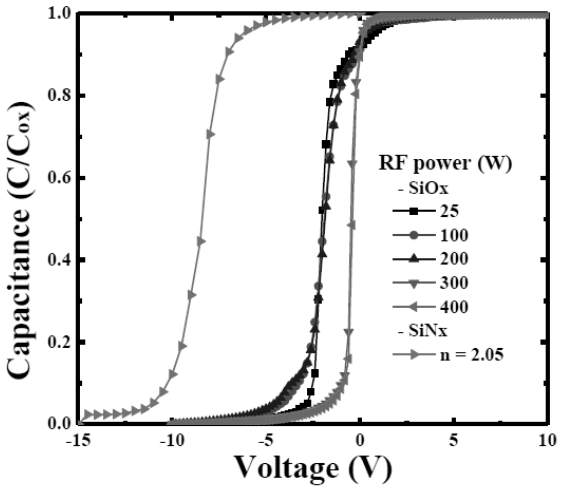

Figure 2. The results of C-V measurement as various RF-power

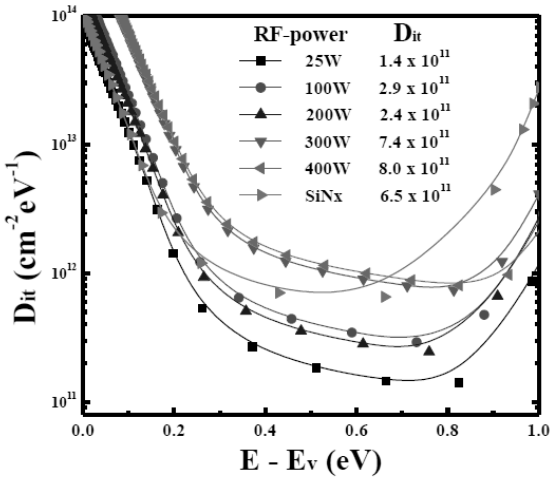

Figure 3. D_{it} characteristic as various RF-power