対向ターゲットスパッタ法による a-Si (i)パッシベーション膜の最適化

Optimization of a-Si (i) Passivation Layer Fabricated by Facing Target Sputtering (FTS) Method

東工大工学院 [1]

(M1)ファリス アキラ ビン モハマド ズルキフリ [1]，中田 和吉 [1]，宮島 晋介 [1]

Dept. of Electrical and Electronic Eng., Tokyo Tech.[1]

Faris Akira Bin Mohd Zulkifly[1], Kazuyoshi Nakada[1], Shinsuke Miyajima[1]

E-mail: farisakira.b.ab@m.titech.ac.jp

[Introduction] The well-known heterojunction with intrinsic thin layer (HIT) silicon solar cells has been proven to be highly reliable with high V_{OC} due to its excellent surface passivation by implementing hydrogenated intrinsic amorphous silicon (a-Si:H (i)). High quality a-Si:H (i) has been fabricated by plasma-enhanced chemical vapour deposition (PECVD) using SiH_4 as the main source gas. In this study, aiming to reduce the fabrication cost by avoiding the usage of toxic gases, we introduced facing target sputtering (FTS) method as an alternative fabrication process for a-Si:H (i). FTS was reported to have lower plasma and thermal damage [1]. Therefore, a-Si:H (i) with high passivation quality by a much safer process and lower cost production is highly possible. Optimization of a-Si:H (i) is focused on H_2/Ar ratio, deposition pressure and post-deposition annealing treatment.

[Procedure] N-type 280 μm FZ (100) mono-crystalline silicon wafers with resistivity of 3 Ω cm were used in this study. Before the deposition of a-Si:H (i), HF treatment was done to eliminate the oxidation layer on the Si-wafer. The deposition of a-Si:H (i) by FTS was conducted under 0.15 Pa without heating. After the deposition of a-Si:H (i) layer, annealing treatment in forming gas (FG) ambient was applied in the range of 150~440 ℃. Minority carrier lifetime was measured every time before and after the annealing treatment by the quantum steady state photo-conductance (QSSPC) method.

[Results] Fig. 1 shows the relationship between minority carrier density and minority carrier lifetime of a Si-wafer passivated by approximately 60-nm-thick a-Si (i) deposited at H_2/Ar = 0.2. Lifetime improved drastically from 42 μs just after the deposition to 212 μs at an annealing temperature of 200 ℃. Control of annealing treatment is essential to improve the quality of a-Si (i) layer as the lifetime value decreased when further increasing the annealing temperature. In addition, thickness and H_2/Ar ratio also affect the lifetime value but the best condition is still unclear.

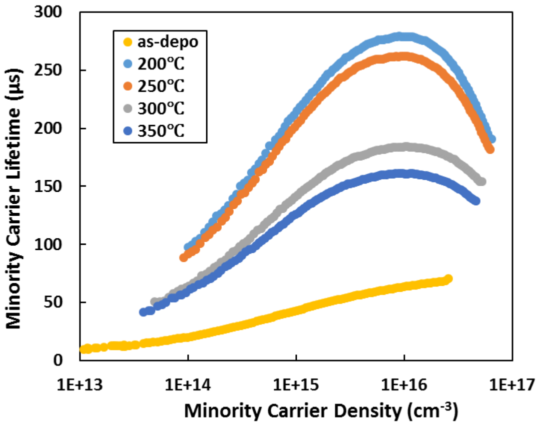

Fig. 1 Minority Carrier Density and Minority Carrier Lifetime relationship in different annealing temperature

[Acknowledgements] This work was supported by the New Energy and Industrial Technology Development Organization (NEDO).

[Reference] [1] Haw-Min Kim, etc. "Preparation of SiOxNy Films by Facing-Target Sputtering System for Thin-Film Passivation Layers of OLEDs," J. Korean Phys. Soc, Vol. 53, No. 3 (2008)