IBC형 태양전지를 위한 균일하게 증착된 비정질 실리콘 층의 광섬유 레이저를 이용한 붕소 도핑 방법

김성철, 윤기찬, 경도현, 이영석, 권태영, 정우원, 이준신*
성균관대학교

Boron Doping Method Using Fiber Laser Annealing of Uniformly Deposited Amorphous Silicon Layer for IBC Solar Cells

Sung Chul Kim, Kichan Yoon, Dohyun Kyung, Youngseok Lee, Taeyoung Kwon,
Woowon Jung, Junsin Yi*
Sungkyunkwan Univ.

Abstract : Boron doping on an n-type Si wafer is requisite process for IBC (Interdigitated Back Contact) solar cells. Fiber laser annealing is one of boron doping methods. For the boron doping, uniformly coated or deposited film is highly required. Plasma enhanced chemical vapor deposition (PECVD) method provides a uniform dopant film or layer which can facilitate doping. Because amorphous silicon layer absorption range for the wavelength of fiber laser does not match well for the direct annealing. In this study, to enhance thermal affection on the existing p-a-Si:H layer, a μc-Si:H intrinsic layer was deposited on the p-a-Si:H layer additionally by PECVD. To improve heat transfer rate to the amorphous silicon layer, and as heating both sides and protecting boron eliminating from the amorphous silicon layer. For p-a-Si:H layer with the ratio of SiH_4 : B_2H_6 : H_2 = 30 : 30 : 120, at 200 °C, 50 W, 0.2 Torr for 30 minutes, and for μc-Si:H intrinsic layer, SiH_4 : H_2 = 10 : 300, at 200 °C , 30 W, 0.5 Torr for 60 minutes, 2 cm × 2 cm size wafers were used. In consequence of comparing the results of lifetime measurement and sheet resistance relation, the laser condition set of 20 ~ 27 % of power, 150 ~ 160 kHz, 20 ~ 50 mm/s of marking speed, and 10 ~ 50 μm spacing with continuous wave mode of scanner lens showed the correlation between lifetime and sheet resistance as 100 Ω/sq and 11.8 μs vs. 17 Ω/sq and 8.2 μs. Comparing to the singly deposited p-a-Si:H layer case, the additional μc-Si:H layer for doping resulted in no trade-offs, but showed slight improvement of both lifetime and sheet resistance, however sheet resistance might be confined by the additional intrinsic layer. This might come from the ineffective crystallization of amorphous silicon layer. For the additional layer case, lifetime and sheet resistance were measured as 84.8 Ω/sq and 11.09 μs vs. 79.8 Ω/sq and 11.93 μs. The co-existence of n^+layeronthesamesurfaceandeliminating the laser damage should be taken into account for an IBC solar cell structure. Heavily doped uniform boron layer by fiber laser brings not only basic and essential conditions for the beginning step of IBC solar cell fabrication processes, but also the controllable doping concentration and depth that can be established according to the deposition conditions of layers.

Key Words : PECVD, μc-Si:H, Fiber laser annealing, Lifetime, Sheet resistance, IBC solar cell