Improvement of Silicon Nanowire Solar Cells Performance by Micro-grid metal contact

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In recent years, with enormous advantages of carrier collection and light absorption, Si nanowire (SiNW) solar cells offer a potential to replace the planar Si solar cells. However, there are still some problems of SiNW solar cells at the present. For instance, normal metal grid would shade around 10% of surface areas which limit the light absorption, especially in the SiNW structures because of larger areas in 3D-array. To improve the performance, better front electrodes need to be pursued. A new method using micro-grid metal contact was investigated here to enhance the front contact and maintain the light absorption [1, 2].

SiNW arrays were prepared on 525 μm-thick n-type crystalline Si (100) substrates by using $AgNO_3$/HF solution. Then, p-type shell was deposited by CVD. Some other treatments were applied to improve its performance such as rapid thermal annealing and back surface field layer formation.

For making the micro-grid metal contact (as shown in the Fig. 1), photolithography technique was used: First, photoresist layer was spun on the surface of silicon substrate after ITO deposition process. Next, samples were irradiated under UV lamp through a photomask. Then, negative developing the sample and metal deposition were done. Finally, the photoresist was removed to carry out the micro-grid metal contact.

Fig. 2 shows the I-V curves of two type metal grids and the parameters of solar cell performances. Owning to the shorter transfer distance in micro-grid, the light-generated carriers are easier collected without recombining and higher collection probability increases higher light-generated current. As the results, the short-circuit current density (J_{SC}) was increased from 19.28 to 27.84 mA/cm^2, open-circuit voltage (V_{OC}) and fill factor (FF) were kept at the same level. Finally, the solar cell was achieved a 45% improvement and enhance efficiency from 7.5 % to 10.9%.

Ref.: 1) H.D. Um, Adv. Mater. Interfaces 2, 1500347 (2015). 2) K.T. Park, Sci. Rep. 5, 12093 (2015).

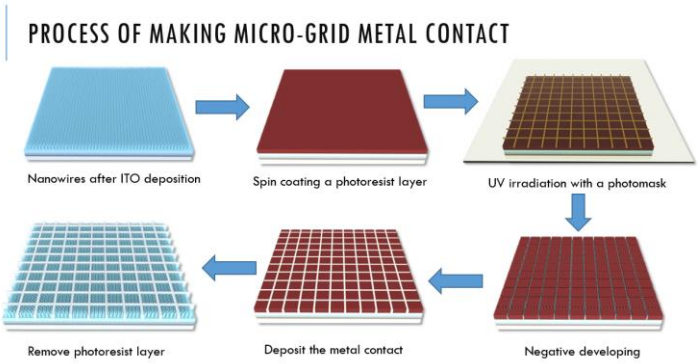

Figure 1. The process of making micro-grid metal contact.

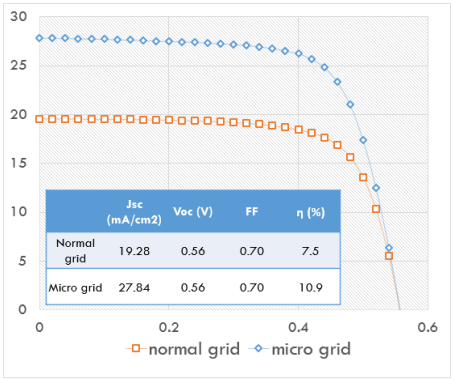

Figure 2. The I-V curves of solar cells and parameters of the solar cell performances.