Light trapping enhanced InGaP/GaAs tow-junction solar cell based on colloidal lithography

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Having been studied for decades, III-V based solar cells demonstrate attractive attention for its outstanding characteristics and performance. But the high cost of III-V materials prevents it from commercial application. There are two ways of cutting down the cost of III-V based solar cells: develop a cost-effective epitaxial growth method [1] and compress the thickness of solar cells to reduce material expenses. Light trapping technology helps on the later point. Although several researches of light trapping on III-V single junction solar cells has been reported [2], application of this technology on III-V multijunction solar cells has not achieved yet.

In this study, an InGaP/GaAs two-junction solar cell is enhanced by colloidal lithography based light trapping, which characterizes its simple and low-cost fabrication processes. In the fabrication processes which is shown in Fig. 1, a mono-layer of silica with diameter of 500 nm is coated on the rear GaAs contact surface of the InGaP/GaAs by spin coating. After that, ICP-RIE dry etching is used for texturing. Then, flip the cell upside down after removing silica particles by buffered HF solution, bonding it on a Si support substrate and remove GaAs substrate together with InGaP etch stop layer by wet etching.

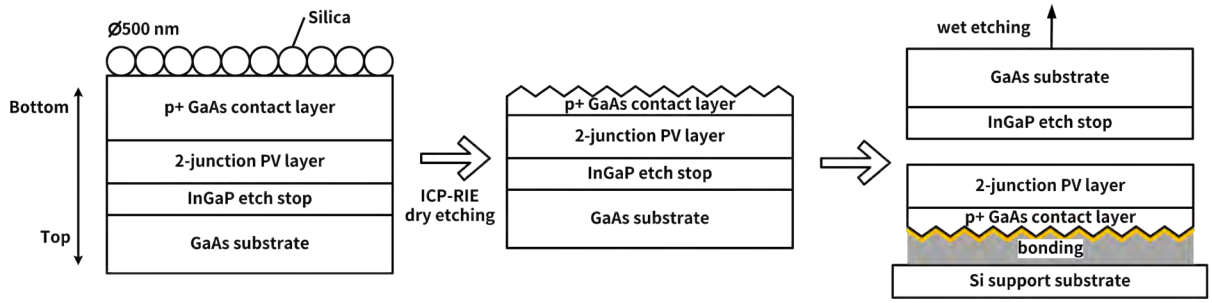
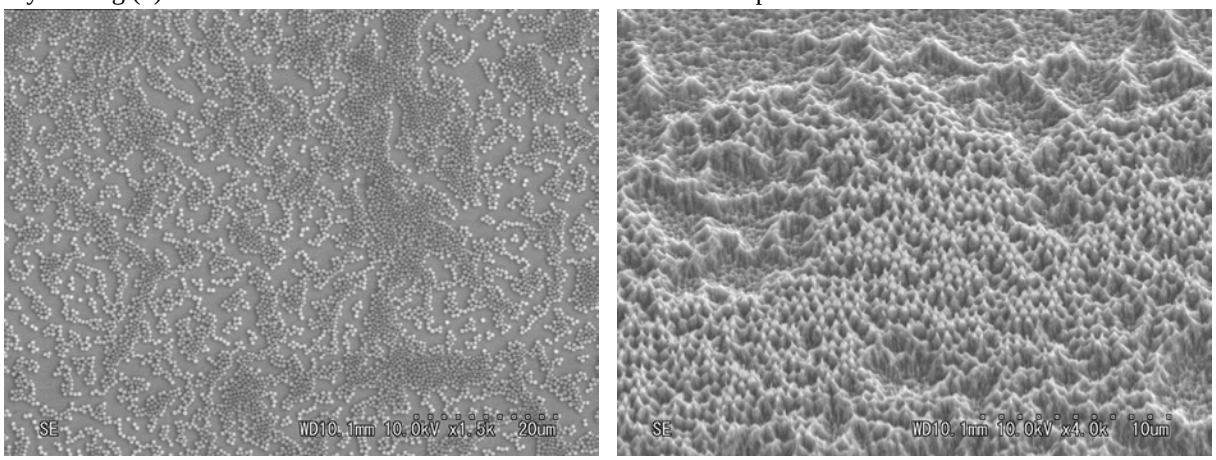


Fig. 1 Fabrication process of colloidal lithography based rear surface texture. The cell is grown by inverted lattice match.

The surface of rear side GaAs contact layer is treated to be hydrophilic by soaking into the 30% H_2O_2 for 24 hours at room temperature. A two-step spin coating is utilized to give a high-density mono-layer silica particle on the rear surface of this solar cell, acting as mask in the following ICP-RIE dry etching process. Fig. 2 illustrate the SEM image of the coated high-density mono-layer silica particles (a) and the formed texture structure by ICP-RIE dry etching (b). Other measurement result will be demonstrated in the presentation.



(a) (b)

Fig. 2 (a) SEM image of a coated mono-layer of silica particles on the rear GaAs contact layer surface. (b) 45° SEM image of the formed texture by ICP-RIE dry etching. Silica particles are already removed.

Reference

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[2] Inoue, T., Watanabe, K., Toprasertpong, K., Fujii, H., Sugiyama, M., & Nakano, Y. (2015). Enhanced light trapping in multiple quantum wells by thin-film structure and backside grooves with dielectric interface. *IEEE Journal of Photovoltaics*, *5*(2), 697-703.