ELECTRICAL ISOLATION OF HIGH-EFFICIENCY DILUTE NITRIDE MULTIJUNCTION SOLAR CELLS

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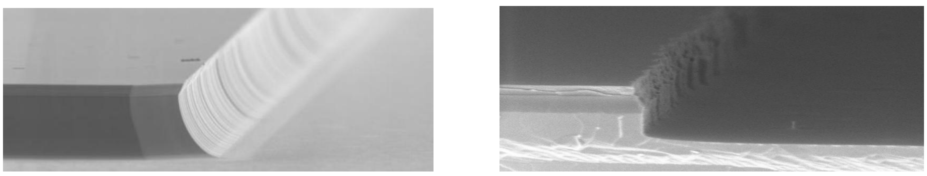
At present, III-V semiconductor multijunction solar cells are the most efficient solar cell type for space as well as for terrestrial concentrator applications. The highest reported conversion efficiencies reaching 46% have been reported for such devices [1]. The majority of commercial multijunction solar cells utilize two-terminal architecture, in which the electrical contacts are made on the top and bottom of the cell. Such a configuration leads to certain requirements for the device fabrication process, especially concerning the terminals. Electrical isolation of the terminals is a crucial step in the fabrication of multijunction solar cells, since poor cell perimeter sidewalls may lead to device malfunction by providing sites for surface recombination, resulting in pronounced leakage currents and nonradiative recombination [2]. The isolation can be done by various methods, e.g., by dicing the cells by cleaving or by fabricating a mesa structure around the top contact using wet or dry etching techniques, as shown in Figure 1.

So far, very little has been published about processing of bulk dilute nitride materials, i.e. GaInNAsSb, which is a novel material system that can be used in bottom junctions of monolithic high-efficiency triple-junction solar cells [3]. Here, we compare and discuss three different isolation methods, including cleaving, wet etching, and inductively coupled plasma (ICP) etching, and their influence on the characteristics of triple-junction dilute nitride multijunction solar cells. The mesa structure prepared using hydrochloric acid based etchant had the highest efficiency and fill factor compared to cleaved cells and ICP-etched cells.



(a) (b)

Figure 1. Scanning electron microscopy images of edges of mesa structures processed by (a) wet etching (height ~2 µm), and (b) ICP etching (height ~300 nm).

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[2] A. G. Baca, C. I. H. Ashby, Fabrication of GaAs devices, The Institution of Electrical Engineers, London, United Kingdom, (2005), 350 p.
[3] M. A. Green, K. Emery, Y. Hishikawa, W. Warta, and E. D. Dunlop, Progress in Photovoltaics: Research and Applications 21, (2013), pp. 1-11.