Photochemical lateral etching of GaAs and AlGaAs for low cost III-V solar cells

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The efficiency of a single-junction solar cell is limited to 33% [1]. A potential way to overcome this limit is through the use of tandem solar cells. One of the possible materials for combining with silicon is III-V materials, which have demonstrated the best efficiency for hybrid tandems on silicon (36.1%) [2]. However, the production cost of III-V cells is much higher than that of silicon, mainly due to the cost of the substrate and the substrate removal process [4]. On one hand, substrate reuse techniques like epitaxial lift-off [4] seem to require additional chemical mechanical polishing steps [3], which limit the number of possible reuses.

Here, we investigate photochemical etching of GaAs and AlGaAs sacrificial layers. The etching of GaAs and AlGaAs layers is performed in nitric acid using a developed etching LED setup with in-situ monitoring and control. Further video analysis is conducted to investigate potential limitations of the method.

We observe lateral under-etching of GaAs and AlGaAs layers in AlGaAs/GaAs structures. We achieved lateral etching rates of 0.2 mm/h. We will discuss the etching mechanism and the path to improve further the speed and quality and size of the layers and to increase the etching rates. The final goal is to perform epitaxial lift-off of an AlGaAs cell.

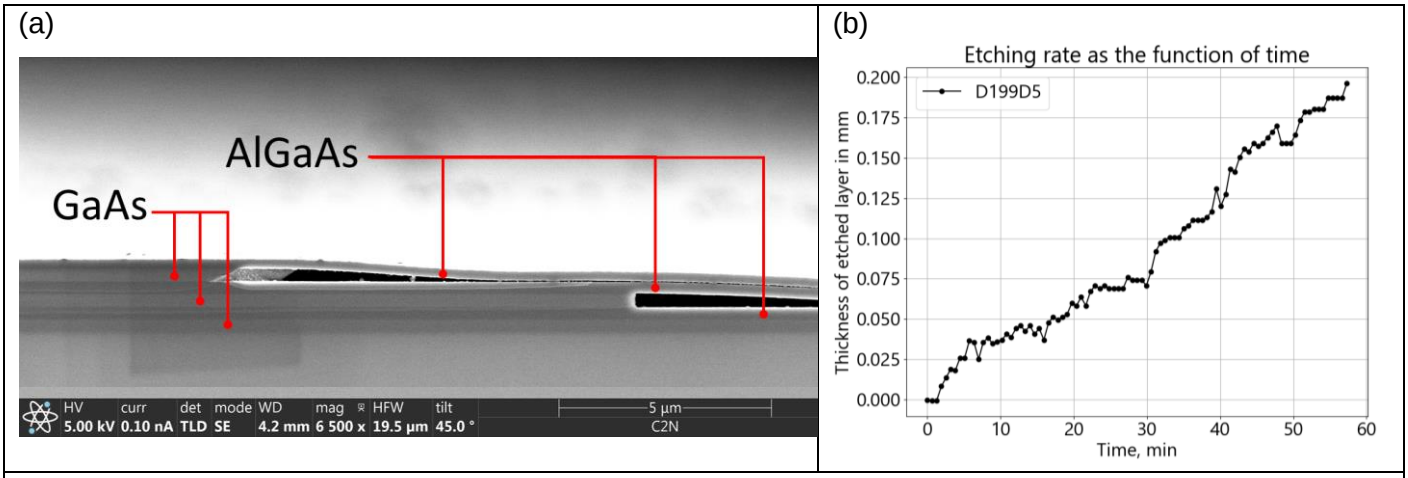

Figure: *(a) SEM Cross-sectional view of the n-GaAs/n-AlGaAs epitaxial structure after photochemical etching, (b) Etching rate measured through the in-situ monitoring camera.*

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