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Process for the Pulsed Laser Ejection of Multiple III-V Thin Film Solar Cells from One Thin Film Growth

Researchers at Stanford have developed a technique that can rapidly and sequentially separate multiple sets of III-V solar cell thin films grown as a stack on one III-V wafer. Their rapid laser liftoff wafer recovery technique may reduce cost and fabrication time by an order of magnitude. Currently, gallium arsenide (GaAs) single crystal growth substrates – used for the best performing solar cells – are expensive and difficult to grow (accounting for an estimated 1/3 of the cost of GaAs solar cells). Because the GaAs solar cells do not depend on the substrate for operation, it is desirable that the solar cell thin films be removed from the GaAs wafer and the wafer reused for multiple growths. The Stanford process, by effectively multiplying the number of cells that may be recovered per wafer reuse, can significantly increase throughput and reduce costs. Moreover, the process is not limited to solar cells and may be used to produce many III-V thin film devices.

Stage of Development
The researchers report that their process achieves the same effect as multiplying the number of possible wafer recovery cycles by x, where x is the number of devices grown per growth process. In other words, if a wafer can be reused 10 times with the laser liftoff process, growing 5 devices per growth would be equivalent to reusing the wafer 50 times, therefore lowering the average substrate cost.

Applications

- Single-crystal III-V optoelectronic thin film devices such as high-efficiency single- and multi-junction III-V solar cells, LEDs, and detectors (e.g., ejected detector arrays).

Advantages

- Leverages the **unique benefits** of laser liftoff relative to other wafer recovery techniques, e.g., the process takes minutes instead of hours and does not require long substrate acid exposure.
- Allows for **multiple devices** from each substrate use.
- Compared to laser liftoff of a single device, this process **reduces** the average **energy consumed** per device produced by utilizing only a single substrate heating and cooling cycle per set of x devices, thus reducing the time for energy payback.
- Precludes poor surface quality issues. Sending the laser pulse through the device instead of the substrate **eliminates the need** to protect the optical quality of the substrate backside (i.e., lower surface) during thin film growths.

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