Laser Wafering of Crystalline Silicon

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Inventors

Dr. Stuart Bowden

Associate Research Professor
School of Electrical, Computer, and Energy Engineering

Background

Currently, silicon ingots used to make solar cells are separated into wafers through the use of wire saws imbedded with diamond chips. As the saw passes through the ingot a strip (kerf) of 160 micrometers is lost as waste material. This accounts for 40% to 50% of the silicon ingot. The sawing process causes microfractures on the surface of the wafer. Additionally, compounds are used to lubricate the saw which must be cleaned from the wafer before it is manufactured into a solar cell. Between 5% and 10% of wafers become damaged severely enough that they are no longer useable.

Silicon solar cells operate more efficiently when they are made thinner between 50 and 90 micrometers. Current methods for separating ingots into wafers will not allow for cells to be manufactured thin enough.

The cost of manufacturing solar cells can be greatly reduced by reducing the amount of silicon lost in the current sawing processes and by making cells thinner so that it use less material.

Invention Description

The proposed innovation uses a subsurface laser engraving technique. A pattern of subsurface pits are created inside the ingot by a laser, forming a layer of weakness where the layers will be separated into wafers. Wafer thicknesses can be anywhere from 10 to 200 micrometers.

The process produces little kerfs as the pits are 20 micrometers in diameter. By generating pits the wafer can effectively be cut from the ingot. The entire ingot can be cut in one process starting from the bottom of the ingot working toward the top. Overall, by reducing 90% of the kerf, reducing the thickness of cells, and reducing damage to wafers, manufacturers will realize considerable material savings.

Intellectual Property Status:
Patent Pending

Potential Applications

- Separating silicon ingots into wafers that can be manufactured into solar cells
- Wafering Germanium based substrates
- Other electronics and substrates

Benefits and Advantages

- **Lower Costs** - Reduces 90% of kerf when separating silicon ingots into wafers and allows for production of thinner wafers.
- **Faster Process** – Allows for wafering of a silicon ingot faster in a one-step process.
- **Better Quality** - Reduces the percentage of wafers damaged during wafering from sawing and sawing agents. Fewer surface defects and microfractures.

Contact

Bill Loux

Director of Business Development, Physical Sciences

Arizona Technology Enterprises, LLC (AzTE)

P: 480.884.1992

F: 480.884.1984

BLOUX@AZTE.COM

TECHNOLOGYVENTURES@AZTE.COM