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Crack detection, process control, smart tools

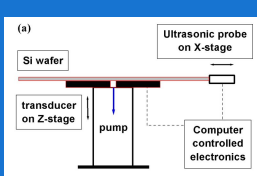
PINHOLE DETECTION IN Si SOLAR CELLS USING RESONANCE ULTRASONIC VIBRATIONS (RUV)

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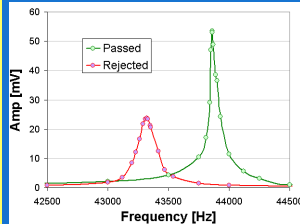
RUV: How It Works



A schematic of RUV system for crack detection in PV wafers and cells

Key components:

- Transducer gives a frequency sweep;
- Ultrasonic probe records resonance curve characteristics: (a) peak position, (b) amplitude and (c) bandwidth;
- proprietary statistical algorithm gives "accept-reject" command;
- Robotic grippers provide load and unload (RUV-2.2)



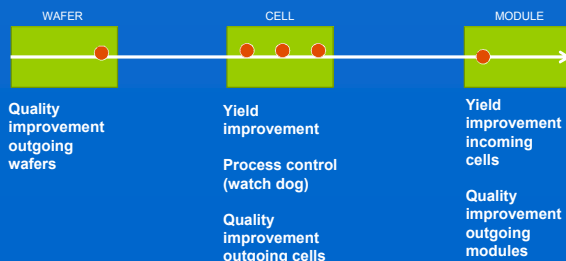
Frequency sweeps: Green – normal wafer, Red-cracked wafer

RUV: Features and Benefits

- 91 – 95 % accuracy of crack detection;
- Higher than 2.0 seconds throughput rate;
- As-cut and processed wafers;
- Finished cells

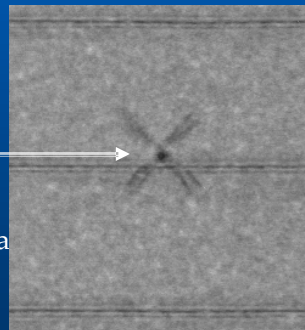
- Real-time feed-back on cracks;
- Non-destructive;
- Cost savings: ~ \$500K/year (10MW module line or 25MW cell line)
- ROI: ~ 3 months
- 24/7, 97% up-time.

RUV: Position in PV Chain



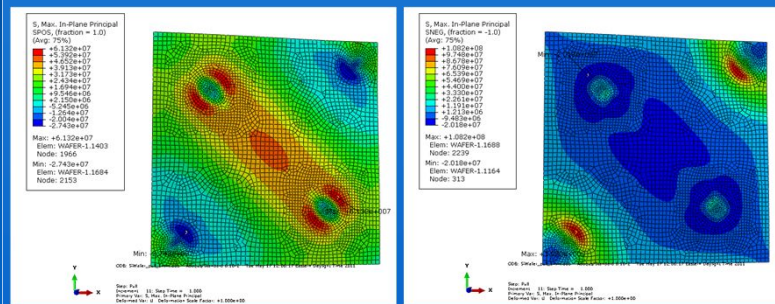
RUV: pinhole / μ -cracks

- A sub-millimeter "pinhole" is a process flaw, source of cell breakage and yield reduction. Pinhole image with HR Scanning Acoustic Microscopy.
- UST developed a protocol to identify Si cells with pinholes using a proprietary Activation Station concept.
- Activation Station passed a high-volume Acceptance Test at a customer location with 100% accuracy of pinhole detection.



3.5 mm

Activation Station: FEA pulling stress



Top surface

Bottom Surface

RUV in Cell/Module Production

www.innotechsolar.com; www.ruvsystems.nl



3 tools, 24/7, ~2.8 sec/cell; 97% up-time; ~10M cells inspected;

Fully Automatic RUV-2.2 with Integrated AS



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