Cold split - A new technology for kerf-less wafering of Silicon

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Freiberg Silicon Days 2015, 18. – 19.06.2015
SILTECTRA – the company

Siletectra developed a novel, copyrighted, kerf-free wafering technology based on the principle of stress induced controlled spalling of brittle materials.

2008  Discovery of fundamental physical effect at Harvard University, Boston, Ma.

2010  SILTECTRA GmbH founded.
Seed Investor: MIG AG, Munich.
MIG has > 500 M€ invested and > 1 B€ signed capital.

2015  Today
- Team of experienced academics and engineers
- More than 40 patents (3 granted, rest pending)
- Successfully splitting Si, Ge, GaAs, InP, SiC, glass
- One of the 100 most promising European ventures
Motivations for "Cold Split" Process

Completely new production enables new applications e.g. ultra-thin wafer <100 µm.

Wafer characteristic, "Cold split" process for better wafer quality specification

Material savings by grinding and wafering in PV & semiconductors
SILTECTRA “Cold Split” Process

"Cold Split": Lift-off thin layers from brittle material wafers or ingots avoids kerf-loss.

Pre-conditioning/cleaning
Optional “perforation layer” by laser
Sacrificial layer
Polymer layer coating
Pre-cooling
Cool down rapidly until split
Remove polymer and sacrificial layer
Optional recycle polymer
Harvest split wafer and reclaim residual wafer

Multiple “Cold Split” - Ingot or wafer reclaim cycle
Principle

1.) Stress Simulation: Temperature stress generates 1.7 GPa tractive force at wafer edge.
2.) Exploiting of extreme expansion coefficient difference of a solid and a polymer
Experiment: “Split Video”

Movie starts with PV grade wafer covered by 3 mm polymer layer. Grid in moisture was added for better visibility.

Movie recorded @20.000 frames/s
Result with “Cold Split”

Cleave example, both halves after split - Polymer removed
Cz-solar-Si, 156x156 mm
"COLD SPLIT" – Laser Conditioning
Key Effect: Multi-Photon Absorption

Normal Absorption

- Elongated focal point
- Little depth penetration
- High risk of surface damage
- High risk of sub surface damage (SSD)

Multi Photon Absorption

- Very small focal point
- Large depth penetration
- Low risk of surface damage
- Low risk of sub surface damage (SSD)
Results "COLD SPLIT" – Laser Conditioning

Silicon
- Siliectra succeeded in laser conditioned splitting of Silicon wafers with diameters of 4", 8” and 12”.
- Geometrical properties of these wafers are excellent, outperforming classical production methods regarding warp, TTV and subsurface damage (SSD).
"COLD SPLIT" – Laser Conditioning Material Results

**Reduction of Subsurface Damage**

Cross section of a silicon wafer after "Cold Split"

Objective: Sub surface damage (SSD) < 20 µm

**Surface Documentation**

Top view of wafer after "COLD SPLIT" with laser conditioning

Objective: Surface roughness 1-5 µm
Conclusions

- "Cold Split" allows full wafer size wafering of brittle material.
- "Cold Split" allows kerf-free wafering of multiple materials.
- Laser conditioning opens up a completely new production method regarding wafer quality parameters.
- The "Cold Split" process produces less warp and surface roughness compared to conventional wafering.
- Siltectra is open for partnerships with
  a) Equipment manufacturer and / or device manufacturer
  b) Chemical supplier.
Thank You!

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