Influence of different pumping technologies on the particle emission during wet processing of GaAs wafer

Christoph Klement

Levitronix User Conference

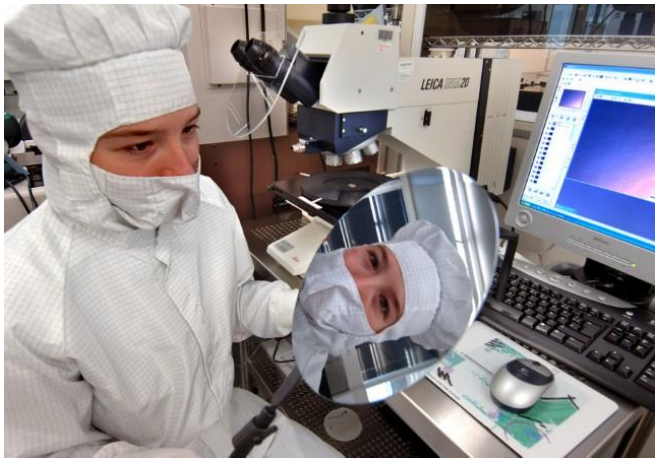
May 2011

Agenda

- Freiberger Compound Materials
- Motivation
- Experimental setup
- Results
- Summary

Freiberger Compound Materials

- Worldwide leader in compound semiconductor substrates
- Main business: gallium arsenide (GaAs), semi insulating and semi conducting
- Wafer sizes: 3" / 4" / 6" / 8"
- Located in Freiberg / Saxony with business activities date back to 1957



Freiberger Compound Materials

Application of GaAs

Microelectronics

- Cellular phones
- WLAN

Semi insulating GaAs

Optoelectronics

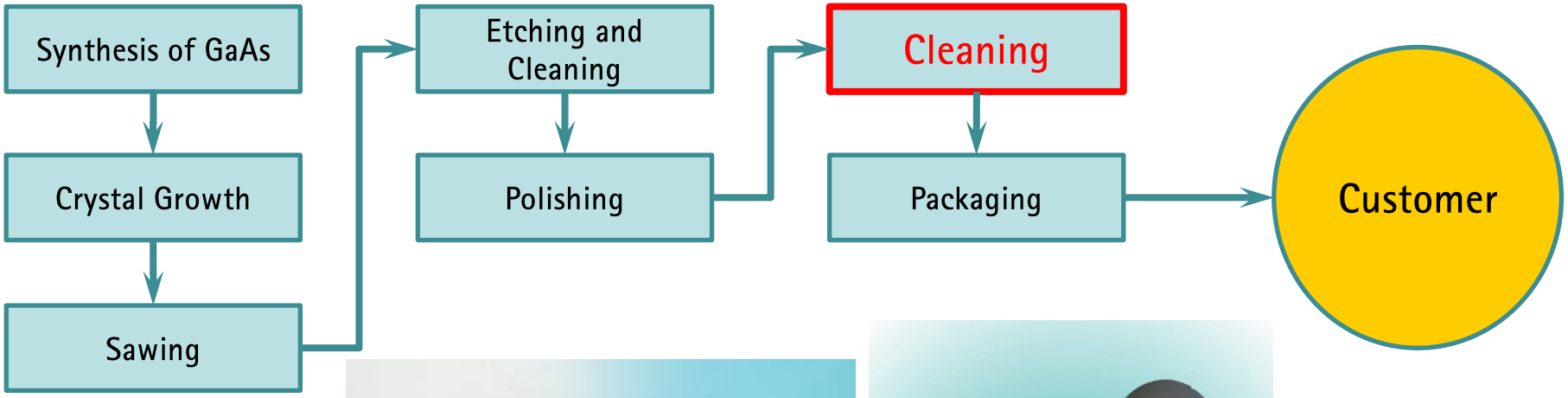
- LED
- Laser

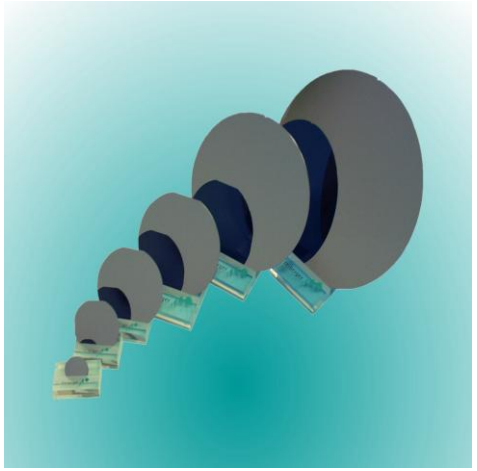
Semi conducting GaAs

Agenda

- Freiberger Compound Materials
- **Motivation**
- Experimental setup
- Results
- Summary

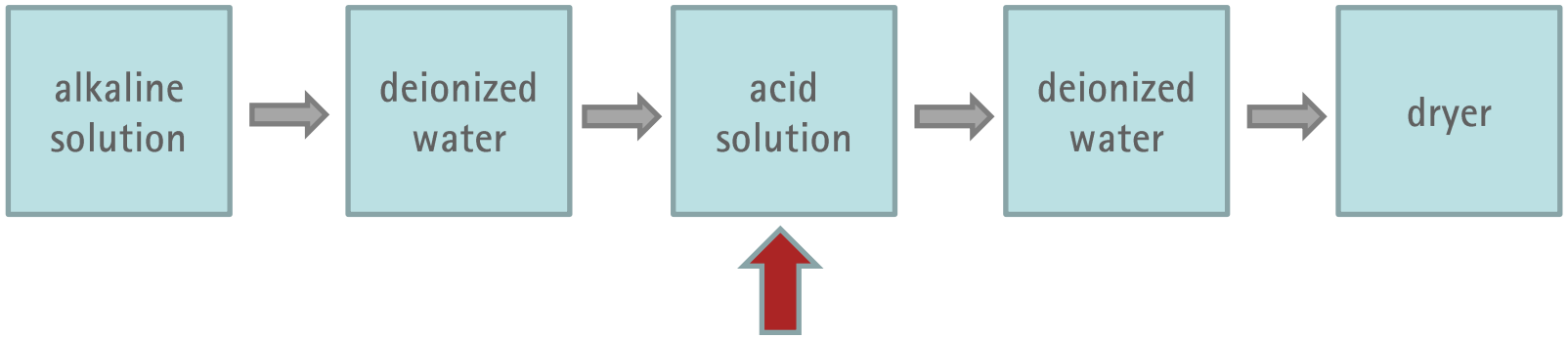
Technology flow





Motivation

Decreasing the number of particles on wafer surface by reducing particles in critical process steps of wet cleaning.



GaAs wafer are sensitive for particle contaminations in acid solutions.

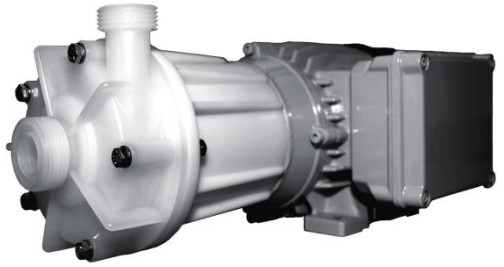
→ need for decreasing particle count in liquid

Agenda

- Freiberger Compound Materials
- Motivation
- *Particles in liquid* – Experimental setup
- *Particles in liquid* – Results
- Summary

Experimental setup – used pumps

- Centrifugal pump with sliding contact bearing

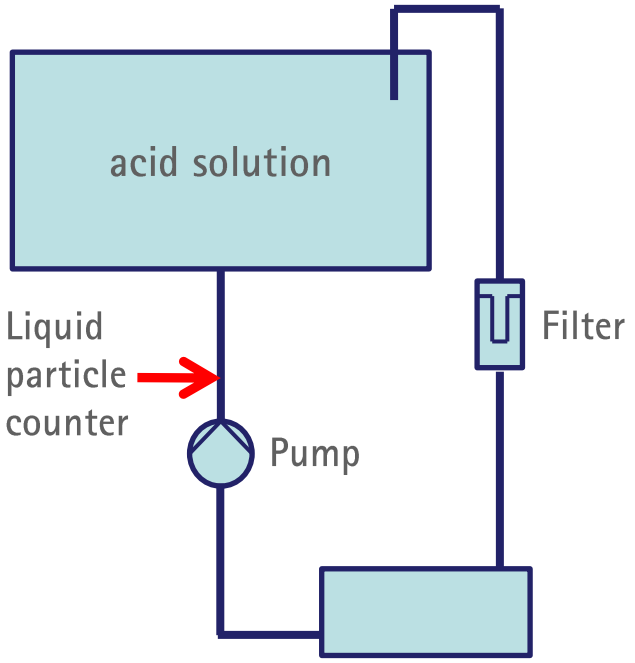


- Diaphragm pump

- Magnetically levitated centrifugal pump (BPS-200 LEVITRONIX)

Experimental setup – particles in liquid

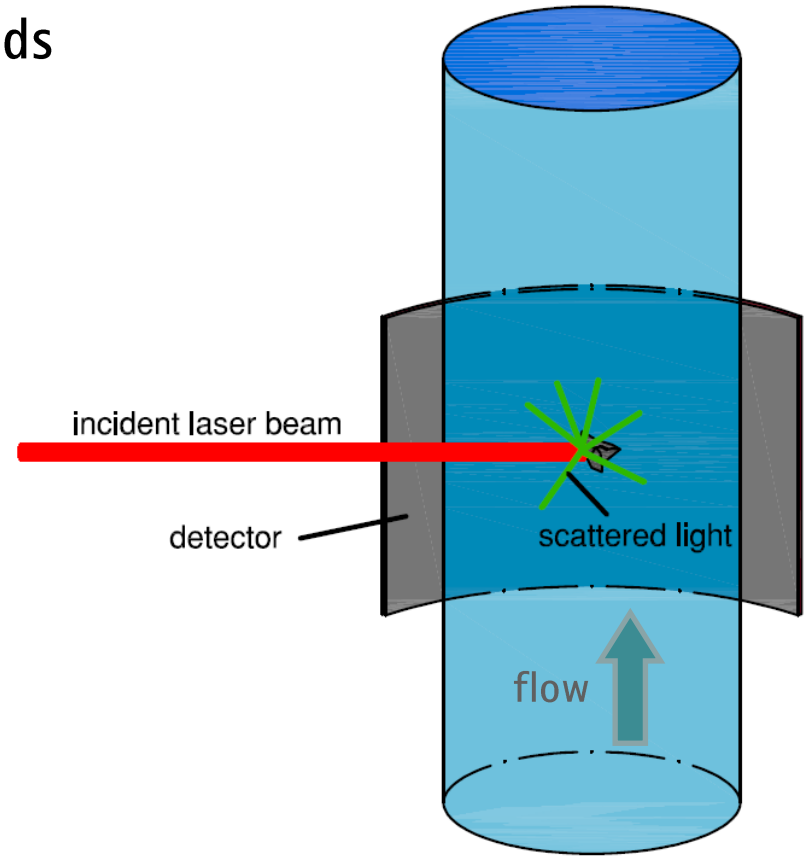
- Integration of each pump into the same wet bench tank (acid solution)
- Flow rate: 15 l/min
- Temperature: 25°C
- Measurement of particles in liquid by laser light scattering



Experimental setup – particles in liquid

Principle of particle detection in liquids

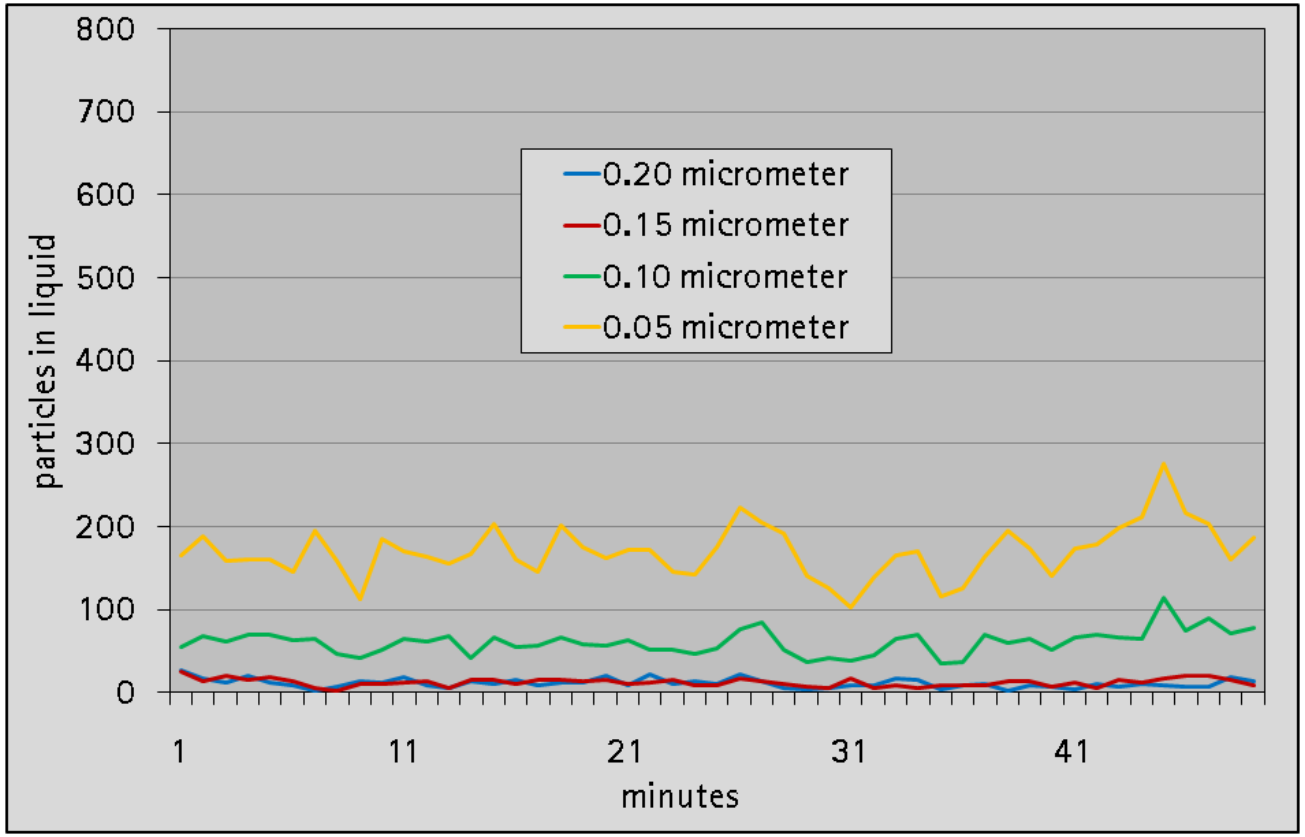
- Non-volumetric measurement
- Laser with 780 nm
- Particle sizes 0.05 – 0.2 µm
- Measurement time: 60s
- Flow rate in capillary tube: 0.25 ml/min



Results – particles in liquid

Centrifugal pump with sliding contact bearing

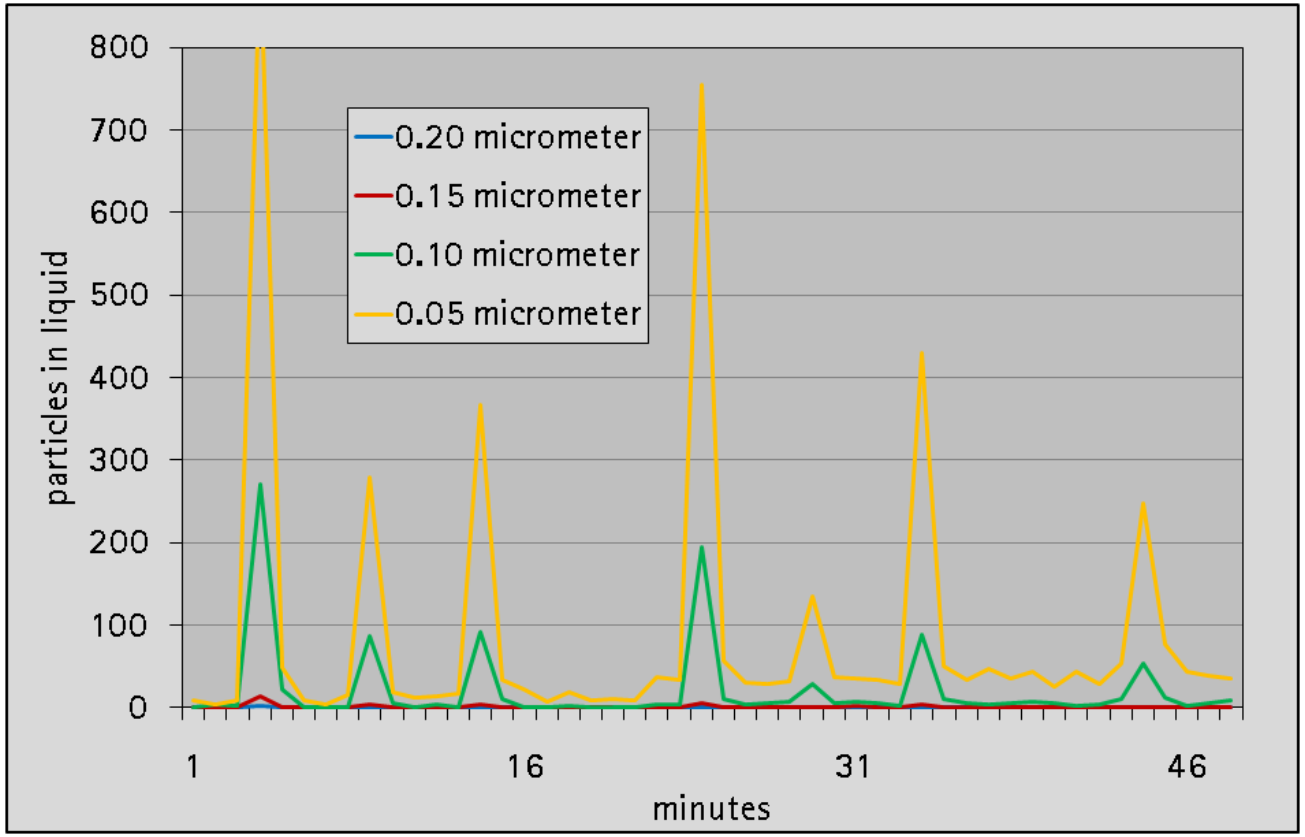
- High particle level
- Unsteady



Results – particles in liquid

Diaphragm pump

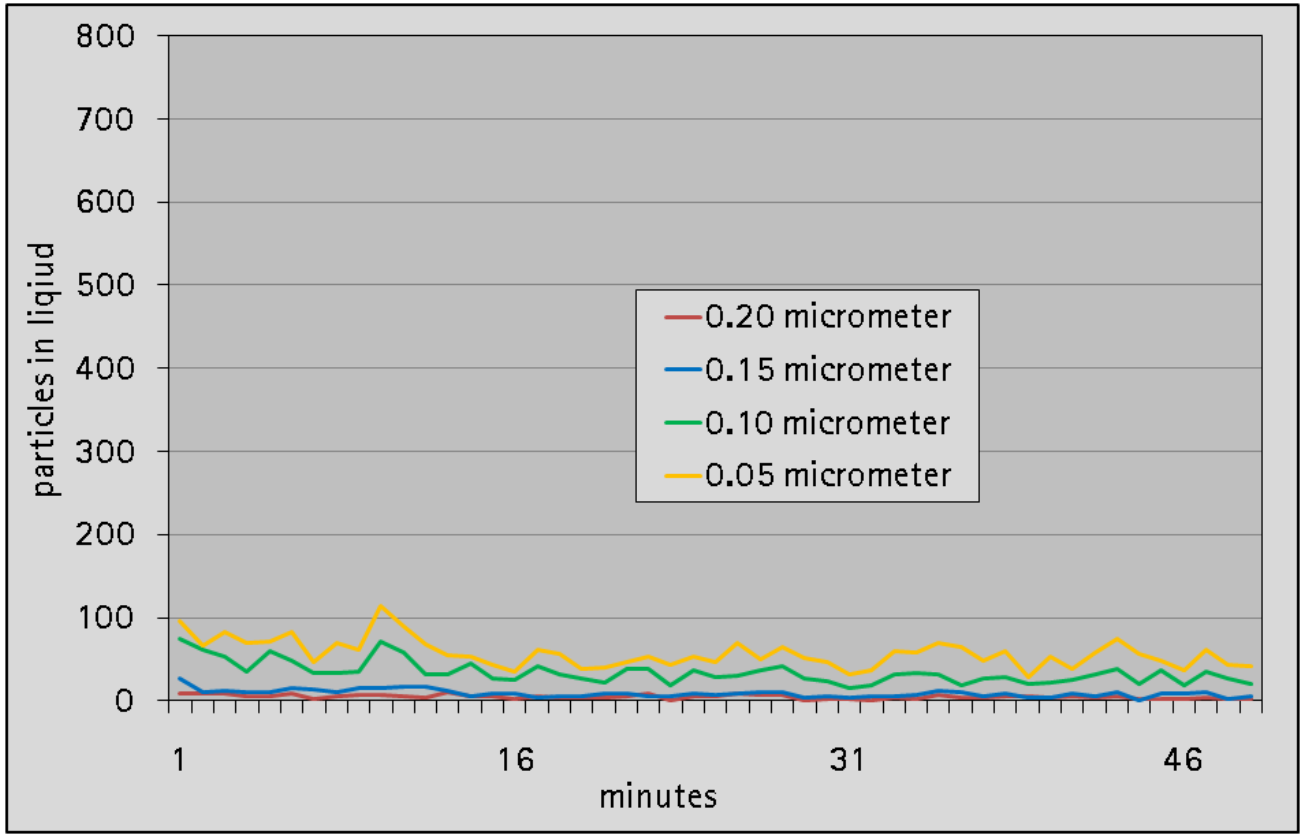
- Very unsteady



Results – particles in liquid

Magnetically levitated centrifugal pump

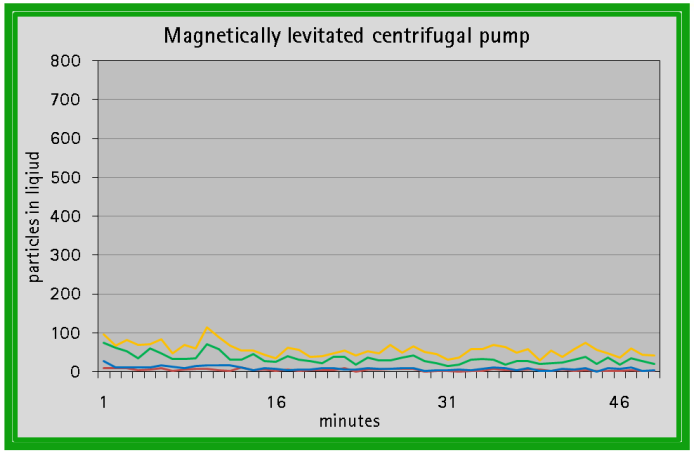
- Lowest particle level
- Steady

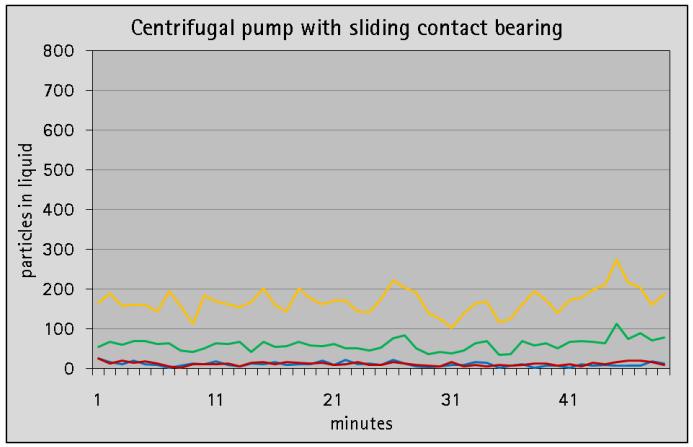


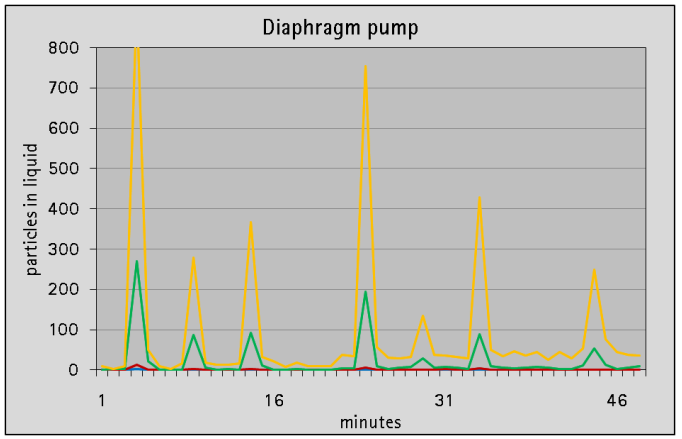
Results – particles in liquid

Results of all pumps - comparison

- Best performance by magnetically levitated centrifugal pump





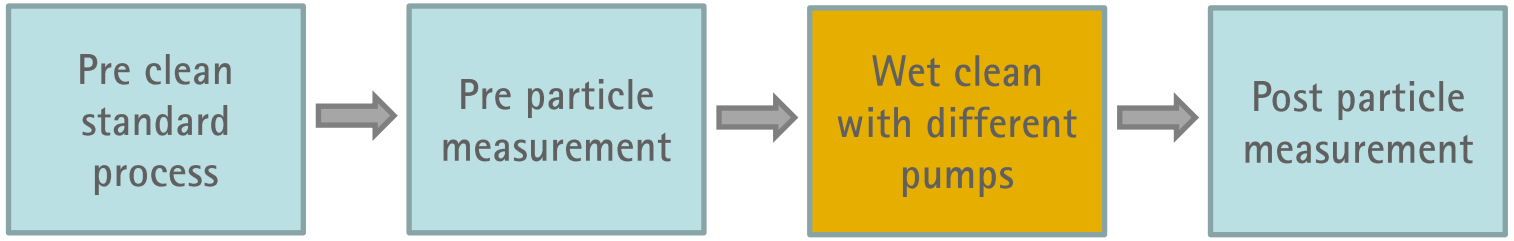


Agenda

- Freiberger Compound Materials
- Motivation
- *Particles on wafer* – Experimental setup
- *Particles on wafer* – Results
- Summary

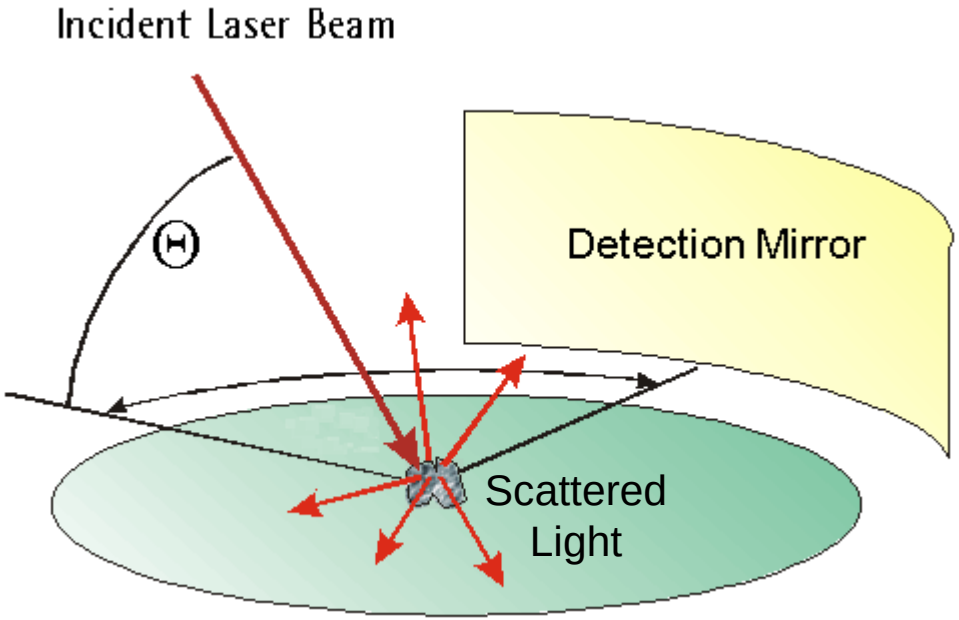
Experimental setup – particles on wafer

Processing pre cleaned wafer on wet bench with different pumps



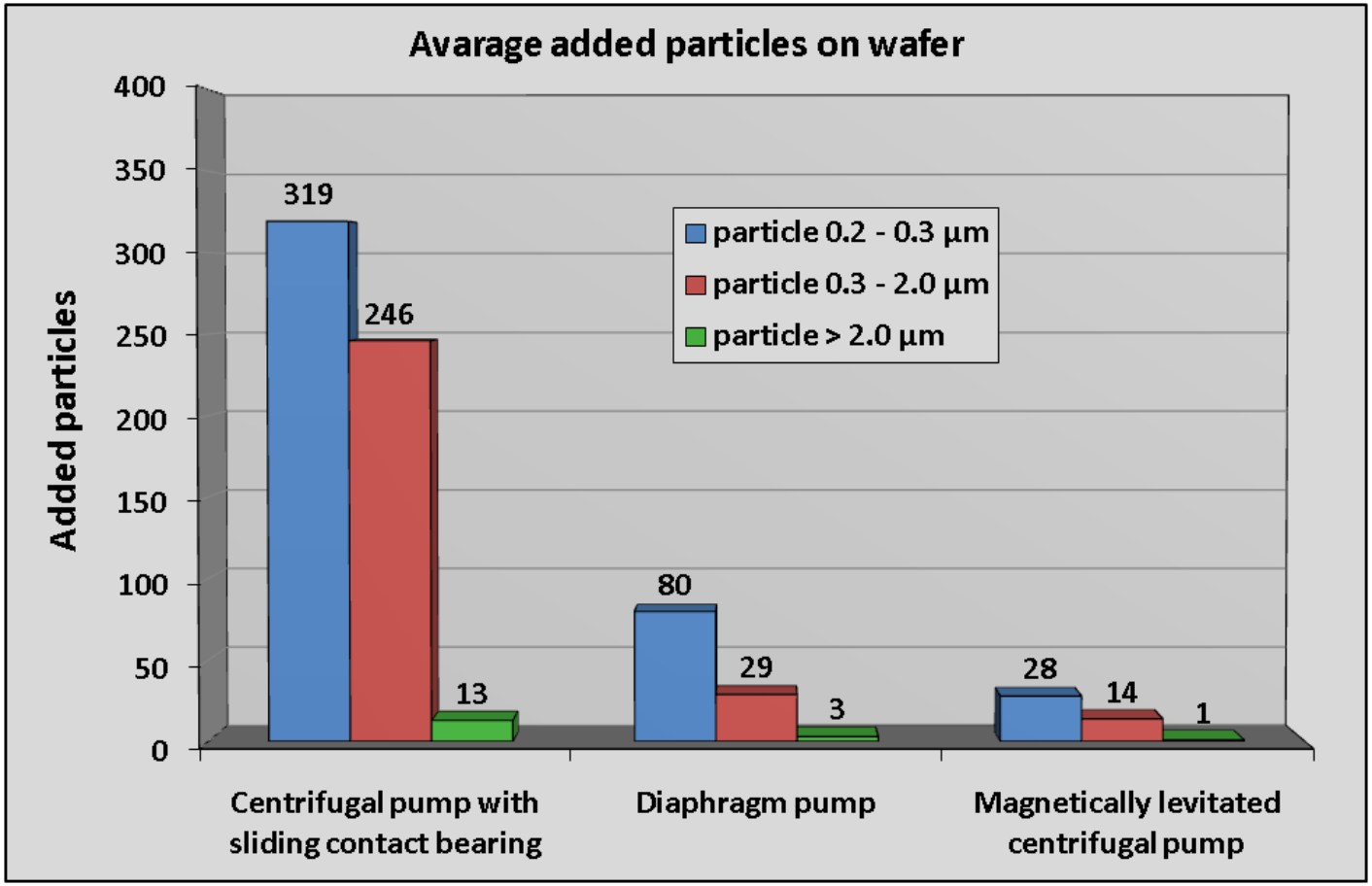
Experimental setup – particles on wafer

Principle of particle detection with Surfscan (KLA Tencor)



Results – particles on wafer

- Magnetically levitated pump shows lowest particle level for all particle sizes
- Confirmation of the particle measurement in liquid



Summary

- The particle count in process tanks is strongly affected by the pumping system.
  → in this test magnetically levitated pump showed best performance

- The particle count on GaAs wafer in acid solutions is related to the number of particles in liquid.
  → also best performance of magnetically levitated pump

Acknowledgement

- Stefan Rümmelin, colleague with strong participation in project

- LEVITRONIX GmbH for a BPS-200 pump and flow meter LFS-20-Z for evaluation