greenict

CMP slurry recycling

Hub 3 - Resource-optimized electronics production Slurry recycling in chemical-mechanical polishing

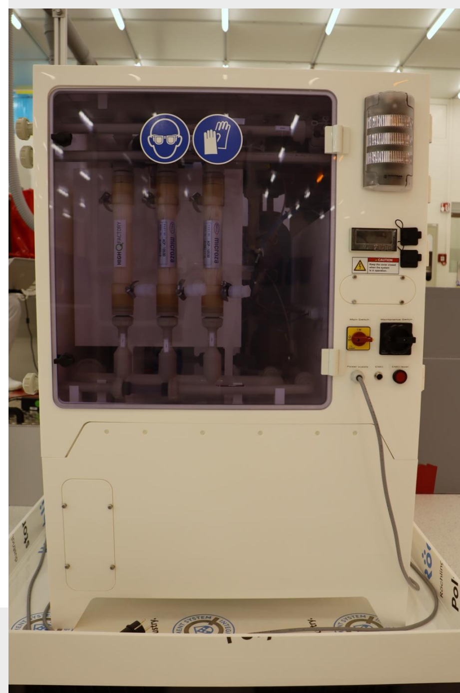
Max C. Klotzsche, Conrad Guhl, Michael Künzler, Wolfgang Eckl

1 recycled slurry

Chemical Mechanical Polishing (CMP) is an essential process in the production of microchips and each wafer goes through several CMP steps. Large quantities of water and polishing suspension (slurry) are consumed and disposed of as waste water. At 60%, the slurry has the greatest influence on the CO_2 balance of CMP [1]. The abrasive particles in particular are complex to produce and consist in part of cerium oxide, a rare earth element and critical raw material.

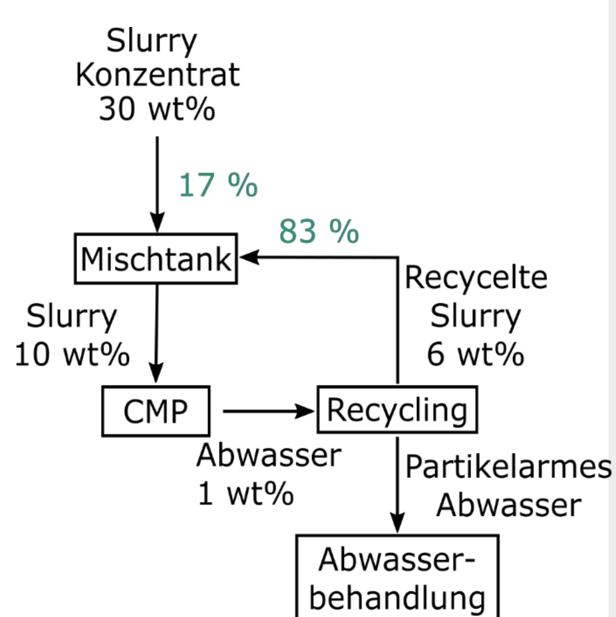
2 Slurry recycling

- Only ~5-20% of the abrasive particles are used during polishing [2]
- Waste water with abrasive particles can be collected and separated from secondary particles (pad abrasion etc.) (filtration)
- Abrasive particles can be concentrated by ultrafiltration, mixed with original slurry and reused
- Original slurry and water for the entire CMP process are saved



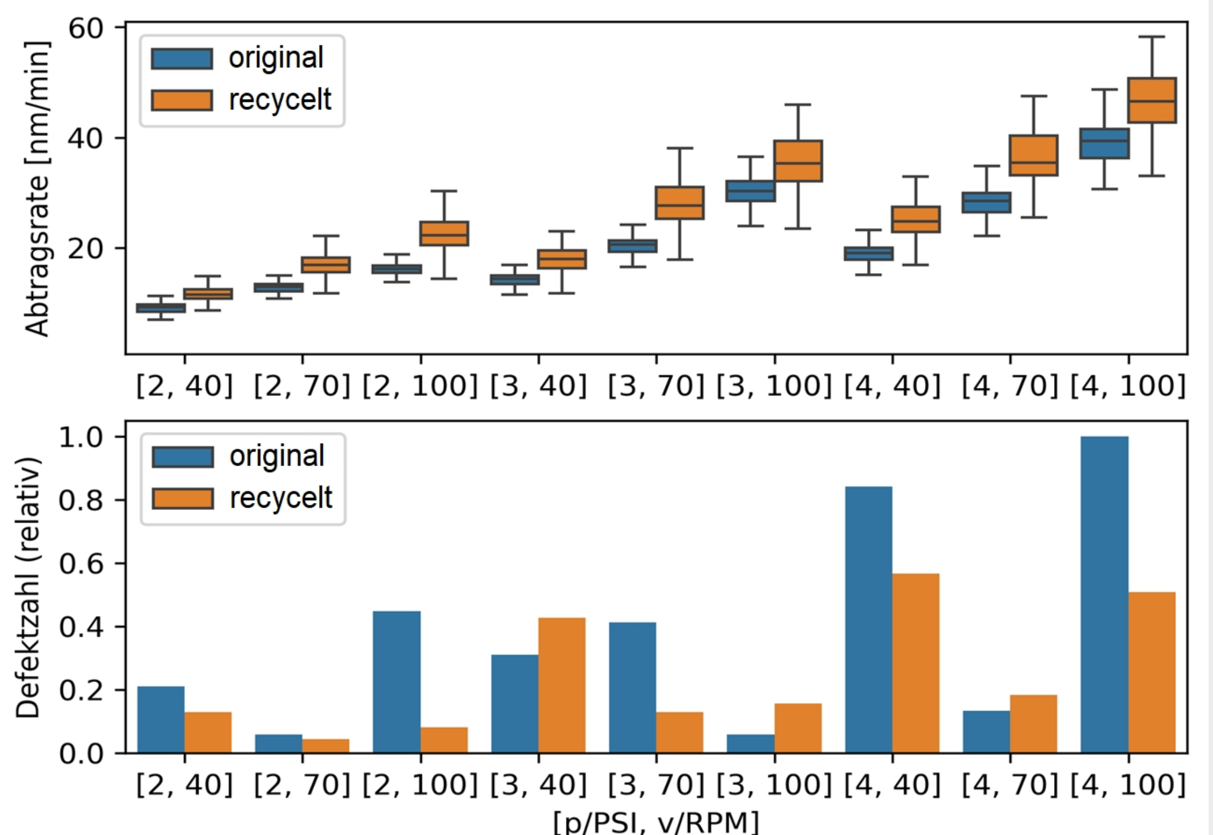
3 Model system

As part of a GreenICT validation project, a demonstration plant for slurry recycling from Fäth was installed at Fraunhofer IPMS CNT. Industrial slurry recycling plants have been in use for 10 years.
on the Market [3] but set itself due to the Custom f and Application-specific only by pilot measures of
The effects on the CMP process, which are to be assessed in terms of their impact, were slow to materialize. As part of the collaboration, a slurry with 10wt% SiO_2 particles was investigated as a model system. For this purpose, wastewater was produced on an industrial 300 mm CMP system and recycled on site using the Fäth system. The polishing behavior of original and recycled slurry on unstructured wafers was then investigated in an industrial CMP process.
compared.



4 IntroductionPolishing behavior original vs.

In polishing tests on unstructured wafers, original and recycled slurry comparable behavior with Print and Speed changes. The slightly increased Removal of the recycled slurry is explained by a slightly higher solids content. A precise control of the solids content is possible, but not part of the current study. The number of defects (>120 nm) shows no systematic difference between the slurries. Overall, the recycling of the investigated slurry does not lead to fundamental differences in the process result.



5 Summary

- CMP consumes large quantities of water and chemicals
- Slurry has > 60% share of CO_2 -balance of CMP
- Particles can be recycled through ultrafiltration
- Successful recycling tests of SiO_2 particles as a model system with a demo system from Fäth GmbH as part of a GreenICT validation project
- Recycled 10 wt% SiO_2 slurry shows comparable results to original slurry on unstructured wafers
- Rare earth oxide CeO_2 widely used as abrasive particles, subject of a follow-up project

[1] Lee, H., Sunjoon P., and Haedo J.. Journal of Mechanical Science and Technology 27 (2013): 511-518.
[2] Philipossian, A. and Mitchell E.: Jpn. J. Appl. Phys. Vol. 42 (2003) pp. 7259-7264
[3] Tang, Tito, et al. 2015 International Conference on Planarization/CMP Technology (ICPT). IEEE, 2015.

Fraunhofer IPMS
FÄTHGROUP focussed on solutions
greenict Forschungsfabrik Mikroelektronik Deutschland
GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung