



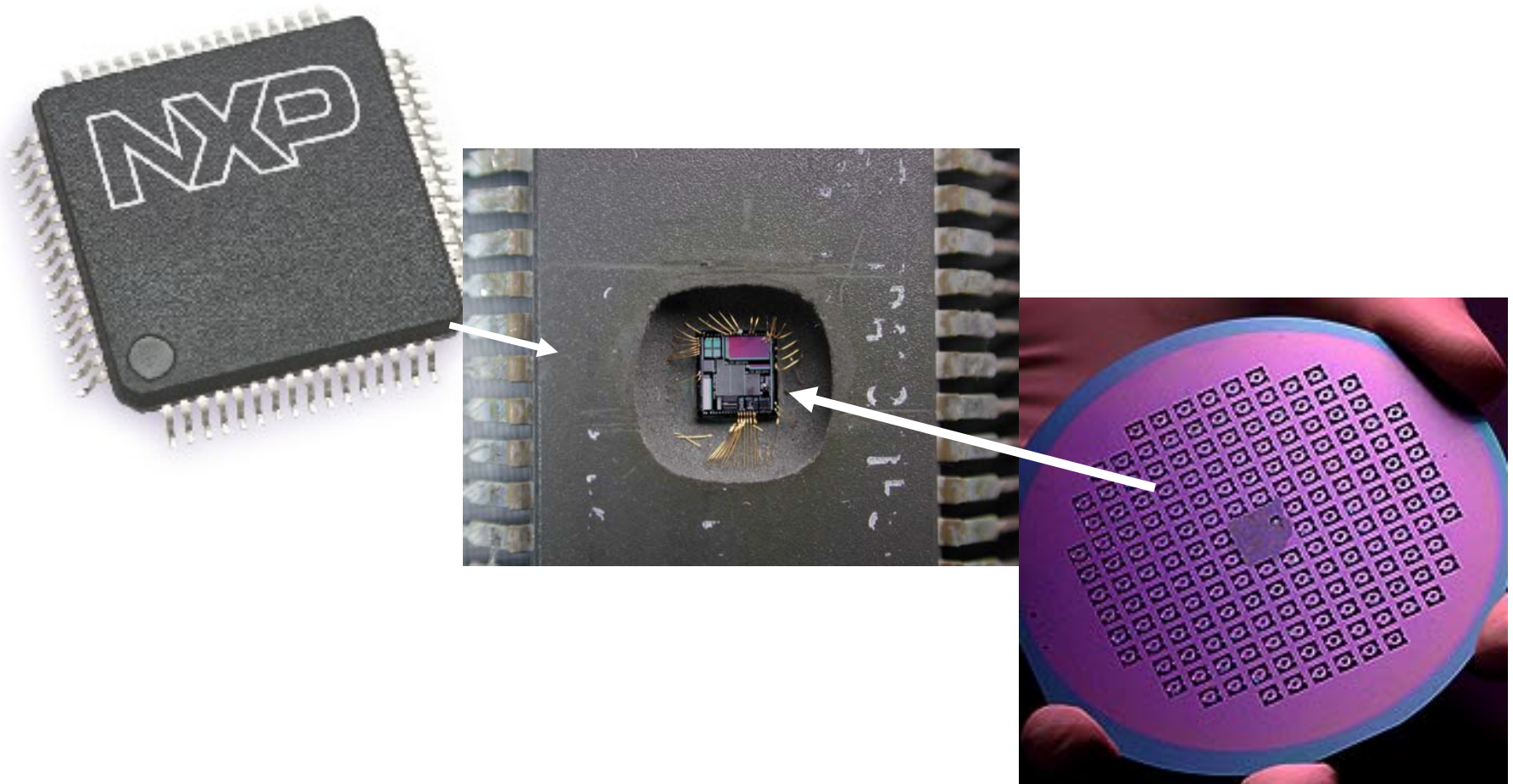
University of Twente

Preparation of mono-disperse silica particles with metal-ion tracer

F. Wali, M. Knotter, J. Kelly, F. Michel, and M. van Straten



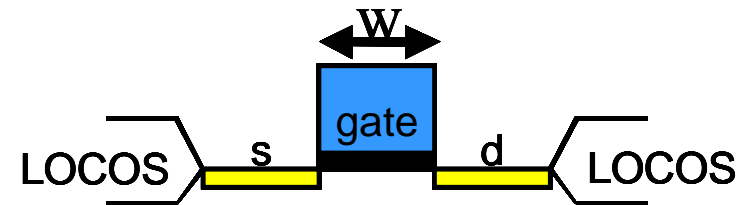
Integrated circuits



Challenges in semiconductor

- Following Moore's law

Introduction year	Target (W)
2005	65
2007	45
2009	34
2011	22

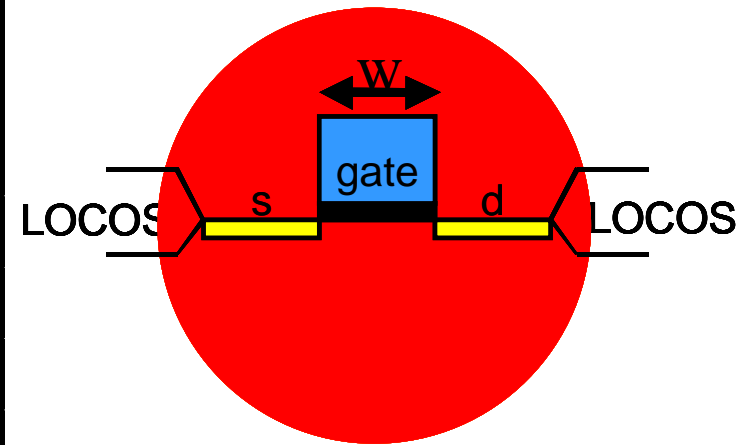


<http://www.itrs.net/reports.html>

Challenges in semiconductor

- Impact of particle

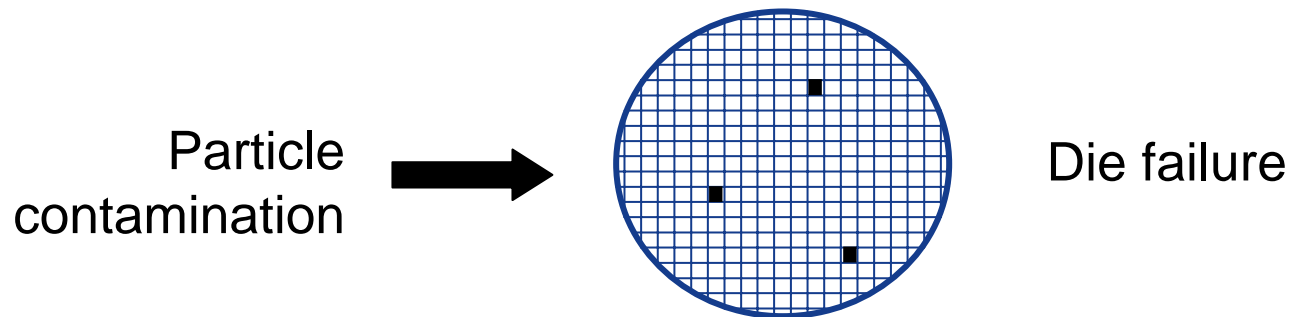
Introduction year	Target (W)	Critical particle diameter
2005	65	32
2007	45	22
2009	34	17
2011	22	11



<http://www.itrs.net/reports.html>

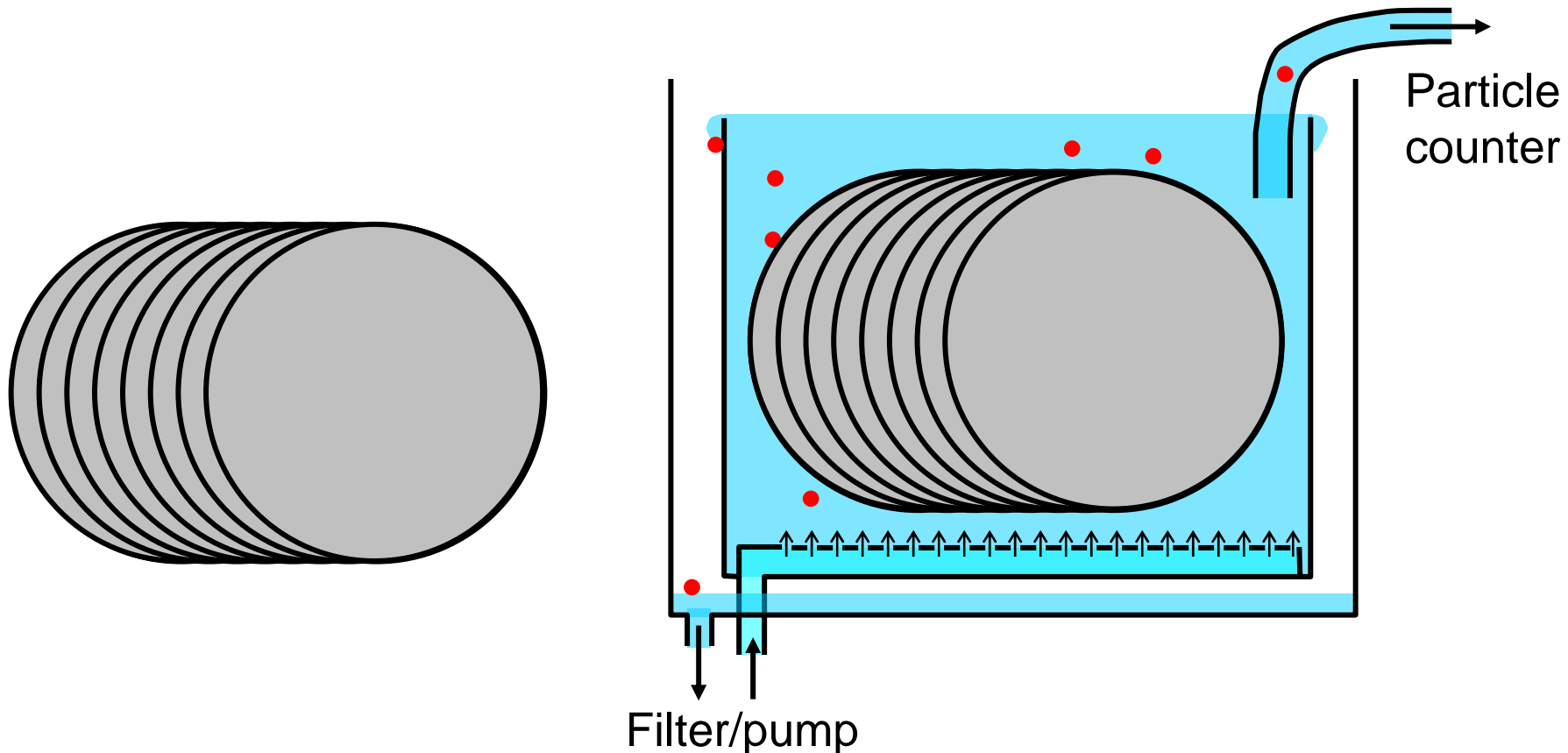
General objectives

- - Impact of particle contamination

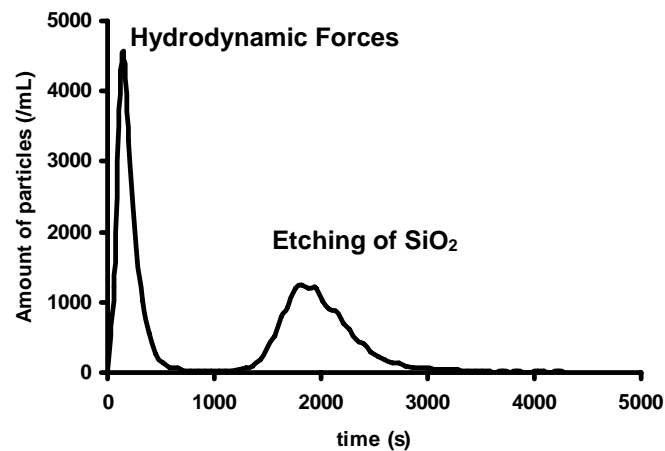
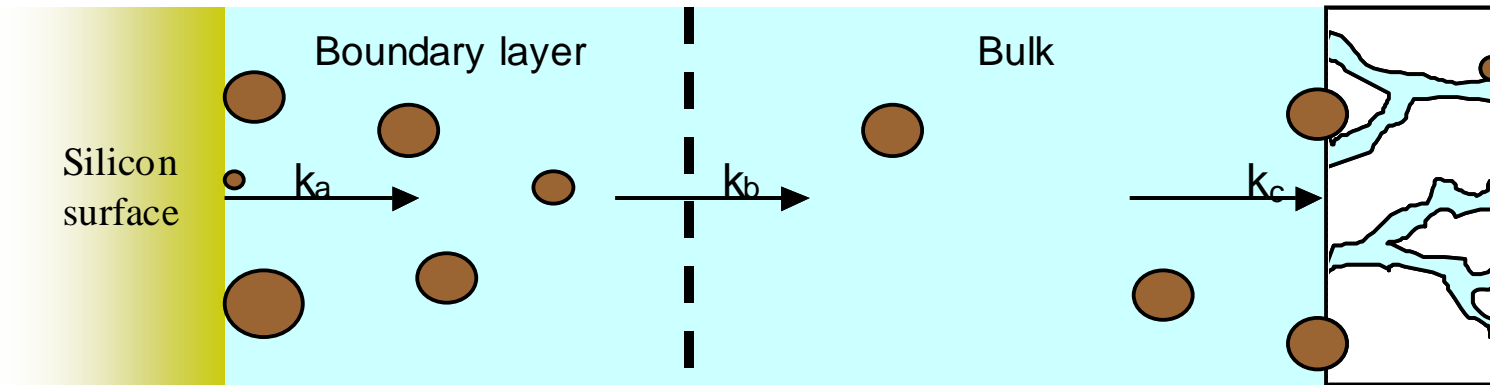


- - Removal mechanisms of particles (<100nm)

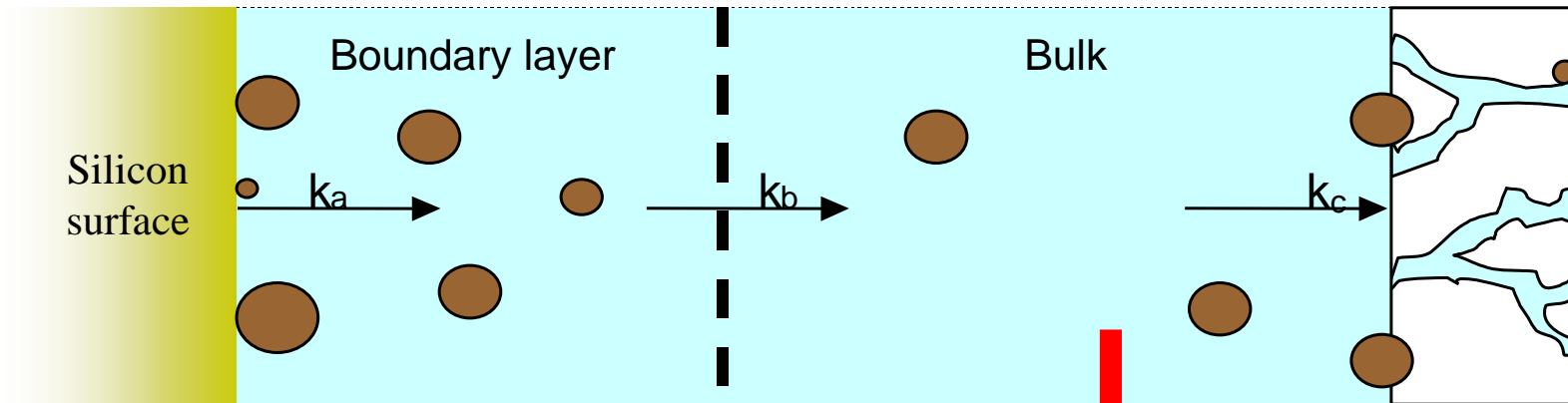
General objective: Removal study



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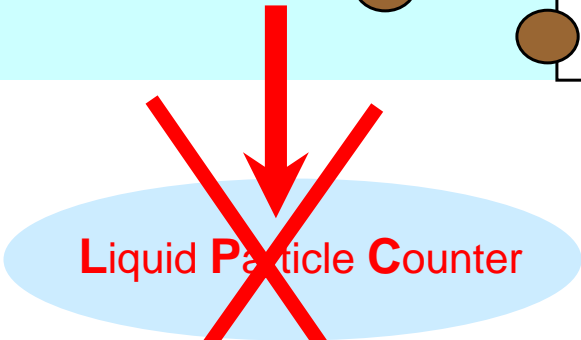
Objective: Detection of particles



Particles with tracer core

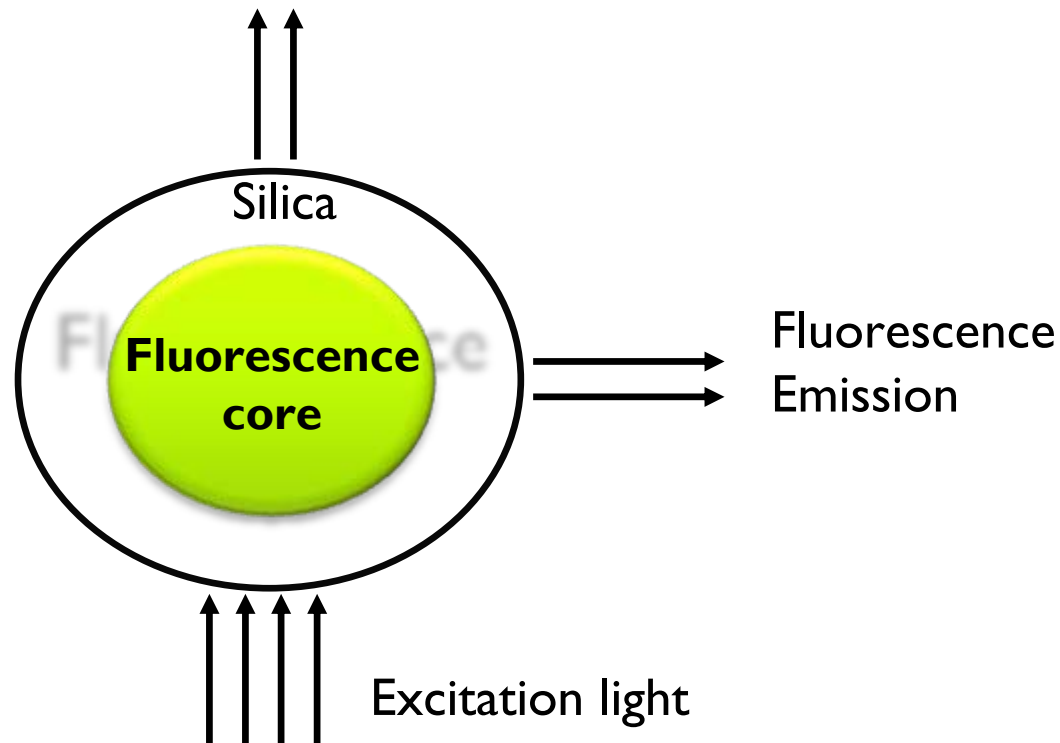


Detection ??



Background noise

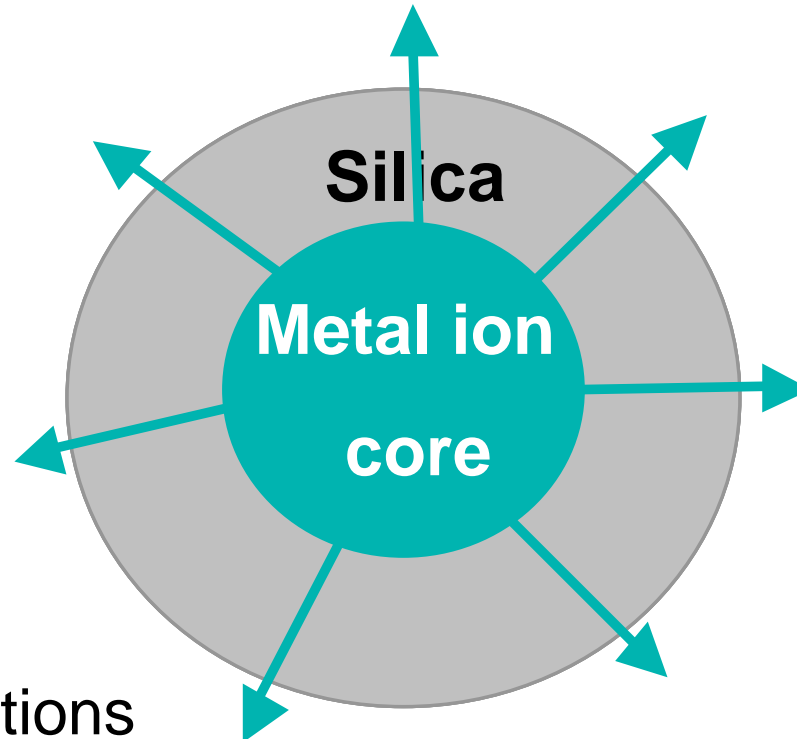
Particles with fluorescence core



BUT

Higher detection limit ($\approx 10^{10}$ particles wafer)

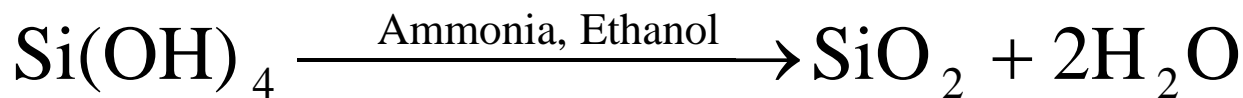
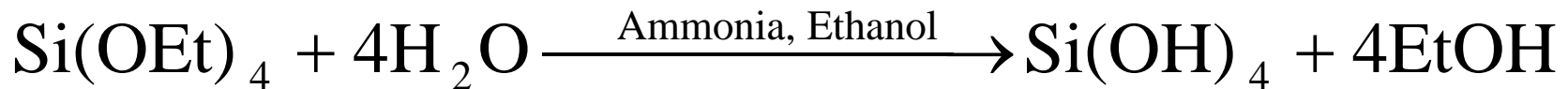
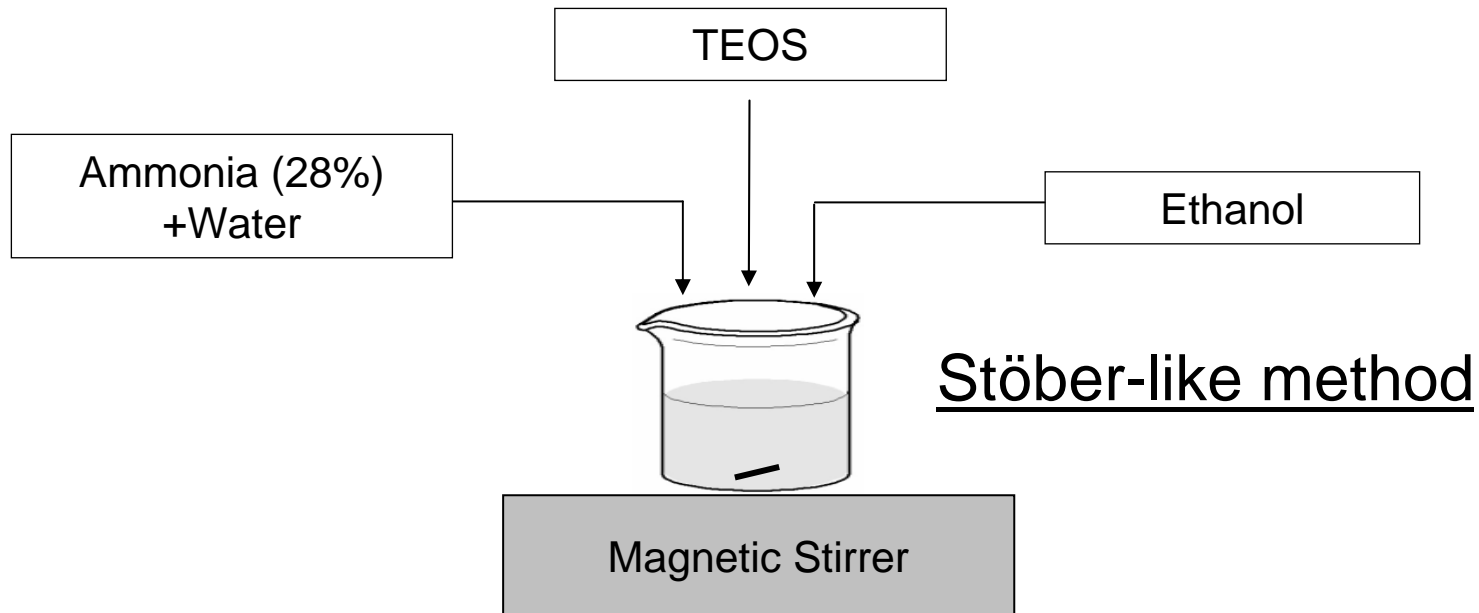
Particles with metal-ion core



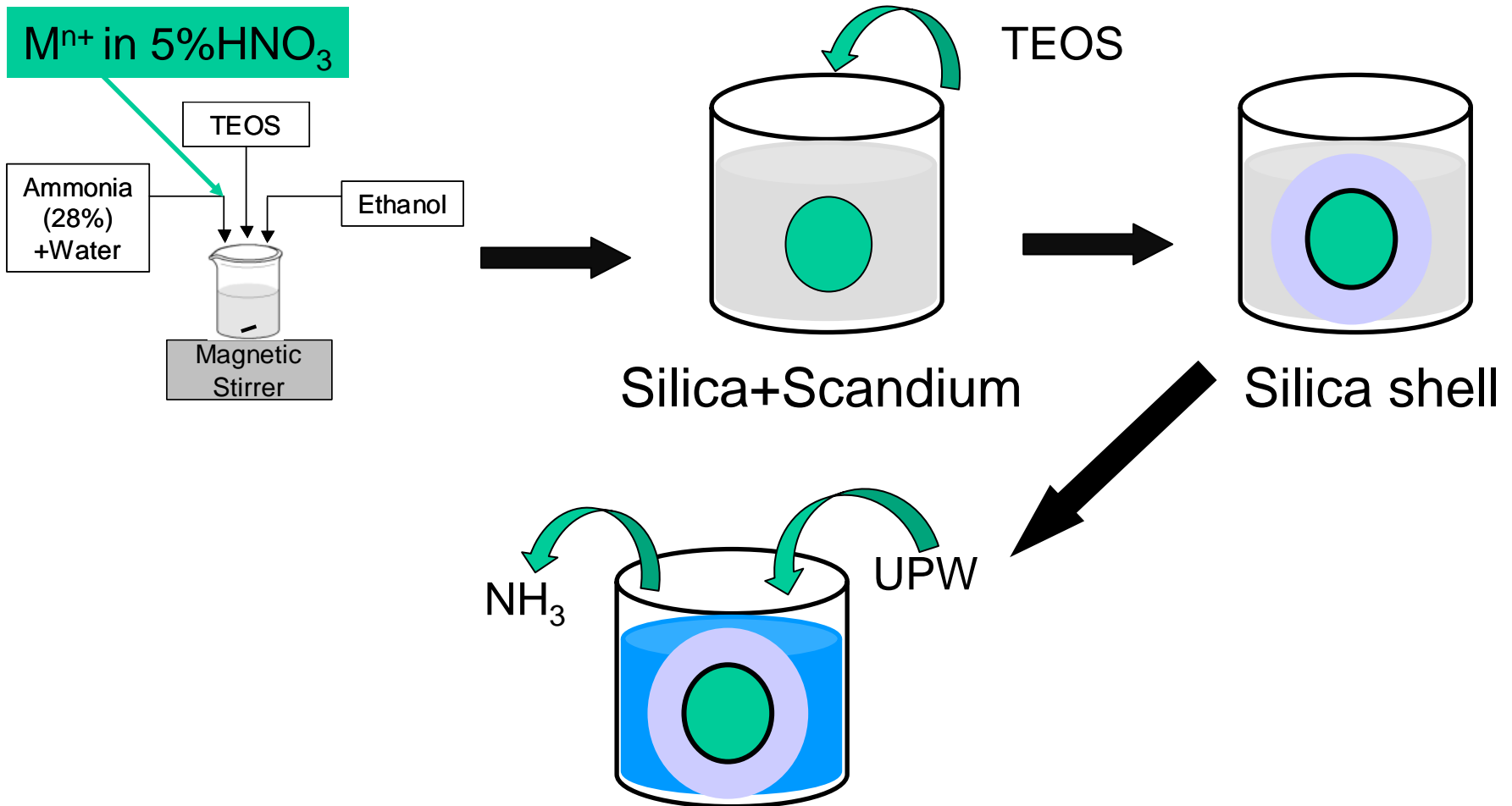
Boundary conditions

- Detection
- Leaching

Synthesis: Silica particles

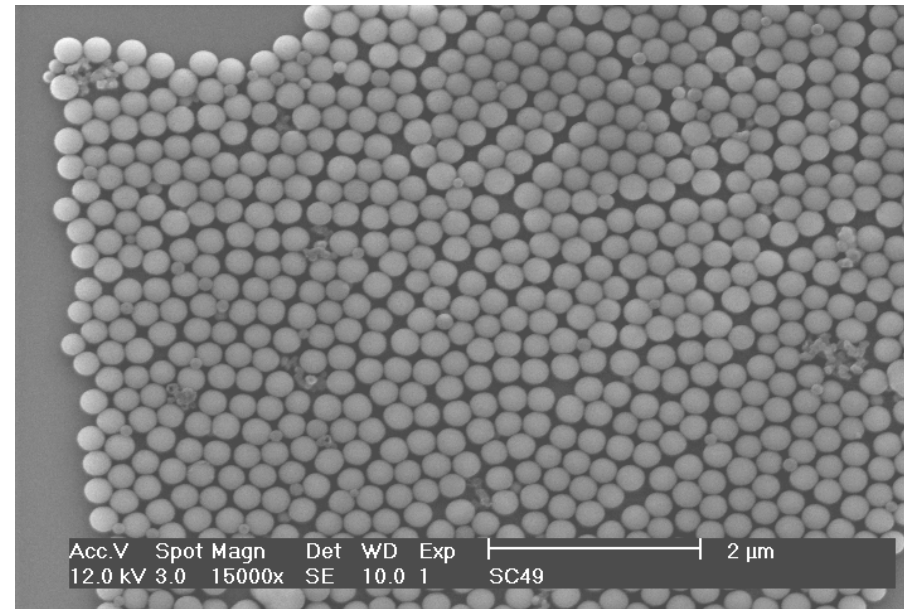
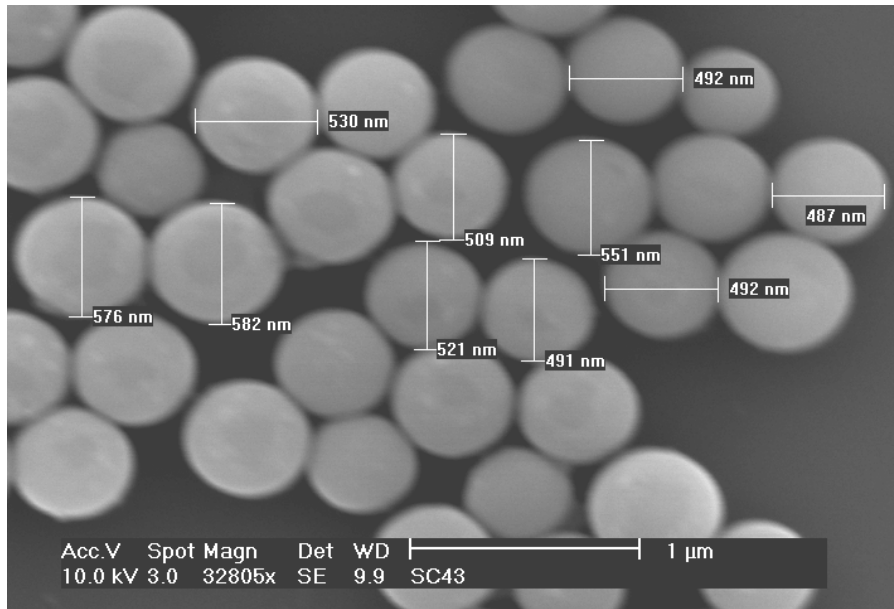


Synthesis: Particles with metal-ion core

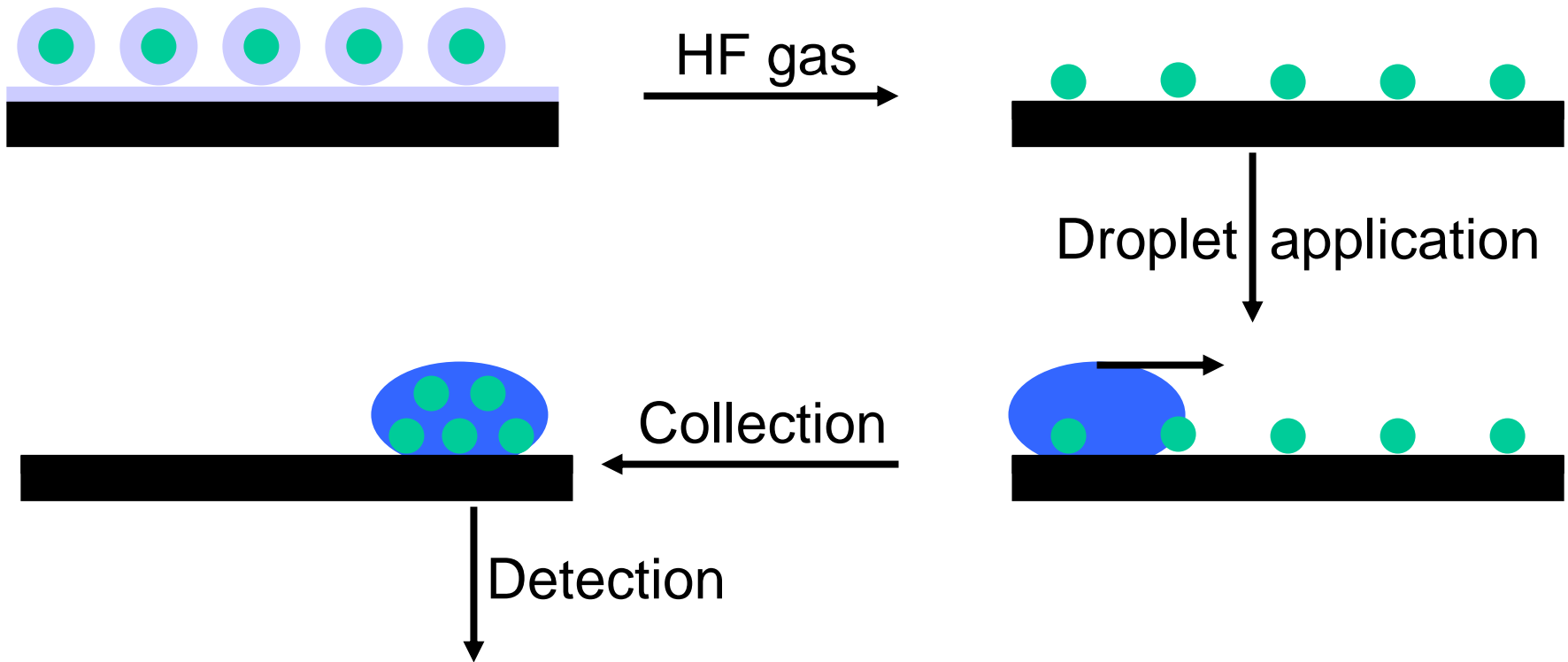


Detection: Scanning Electron Microscope

- Average particle size: 19nm to 540nm
- Mono-dispersity: 9,3% (e.g. 54nm \pm 5nm)



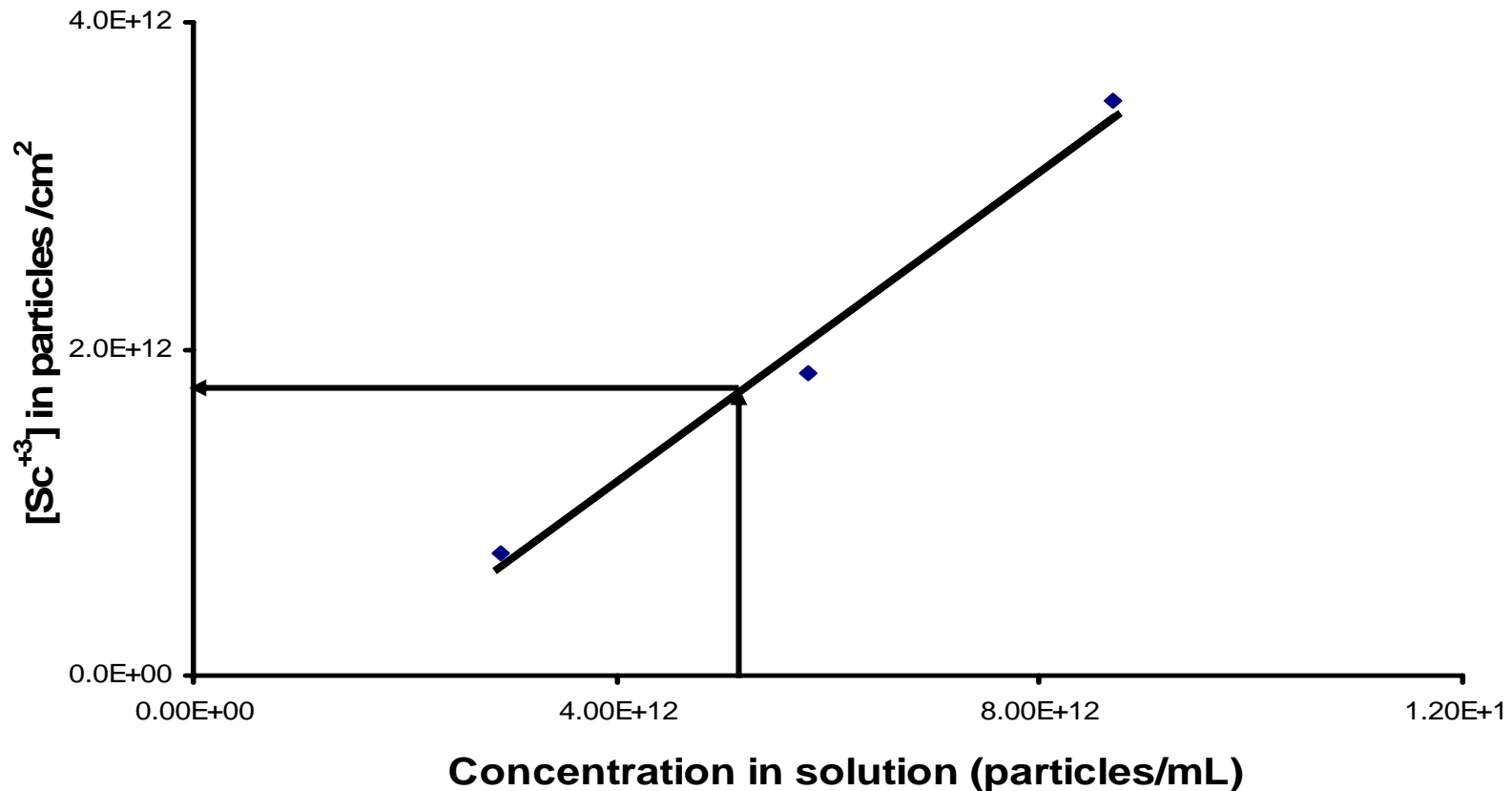
Detection: ICPMS



Metal-ion concentration analysis (ICPMS)

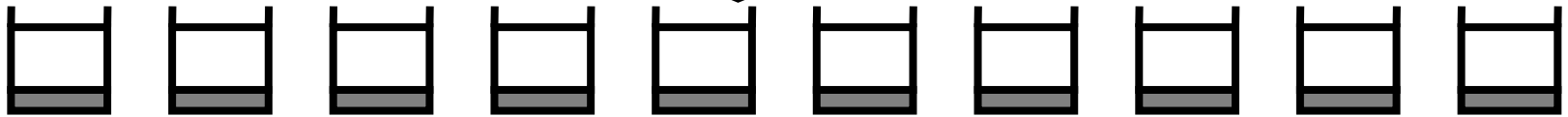
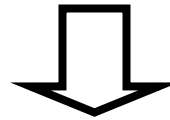
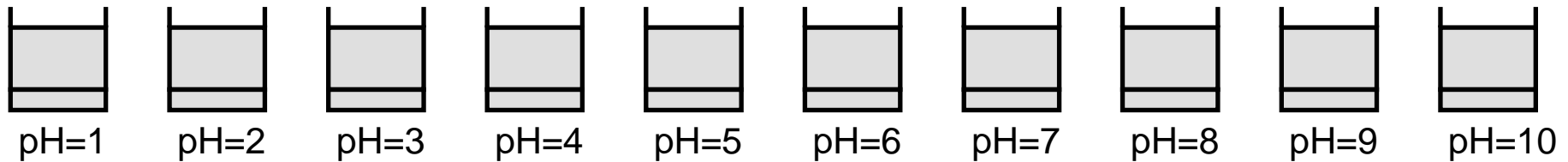
Detection: Particle conc. on substrate

Particle concentration determined by ICPMS

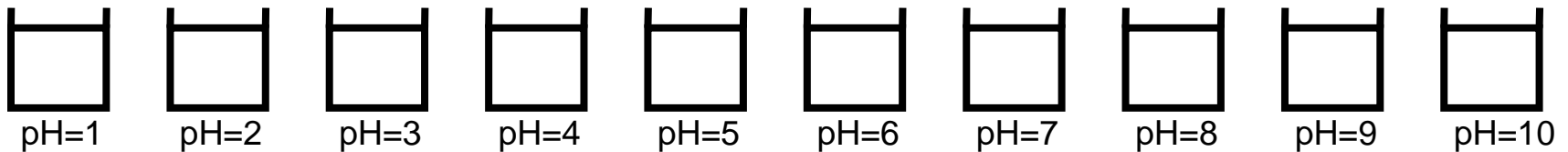


Leaching: Experimental setup

Actual Sample of 63nm silica particles

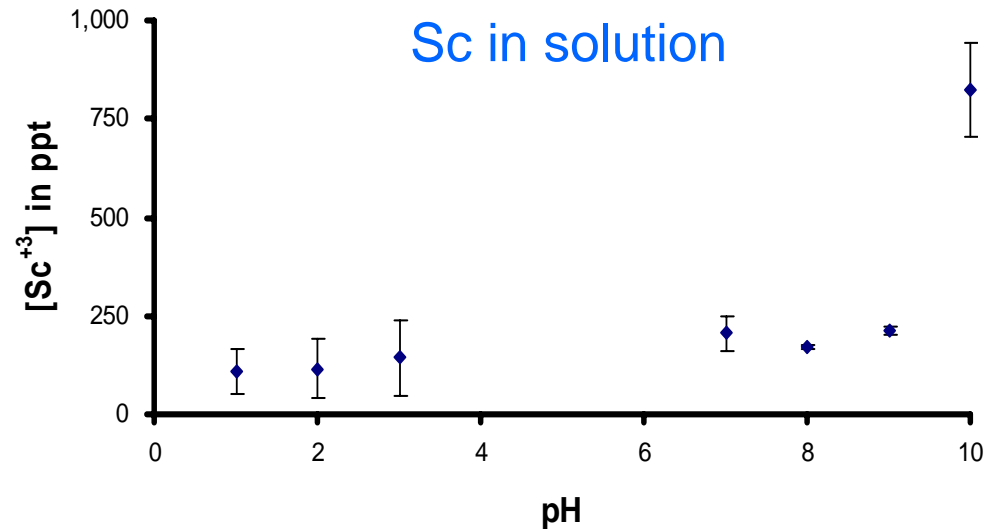
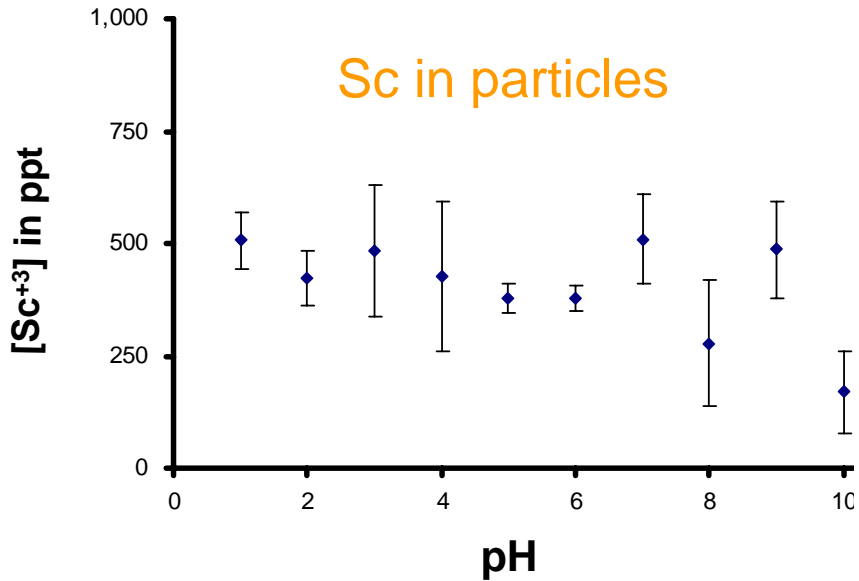


Particles after centrifuge



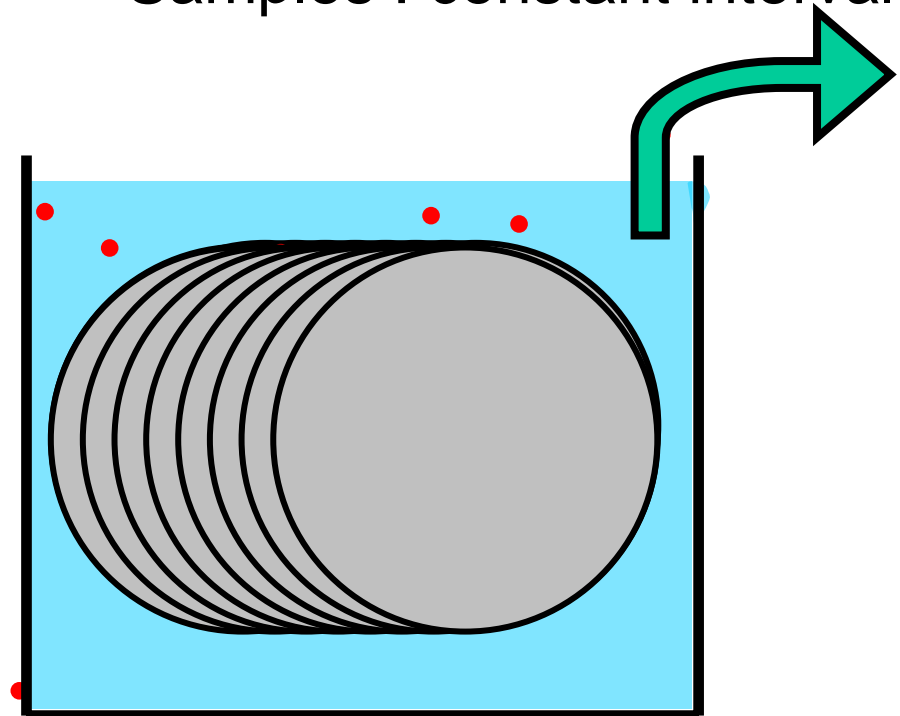
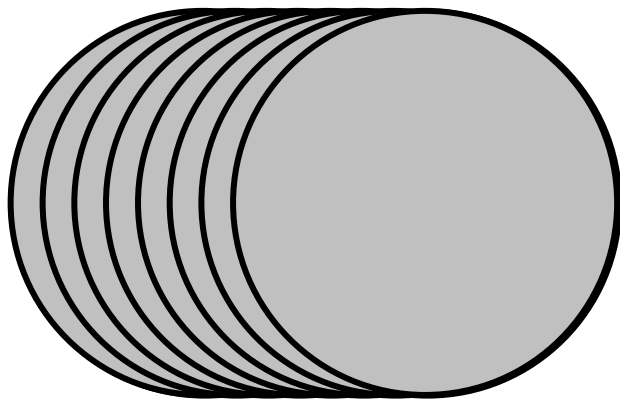
Solution after centrifuge

Leaching: Results

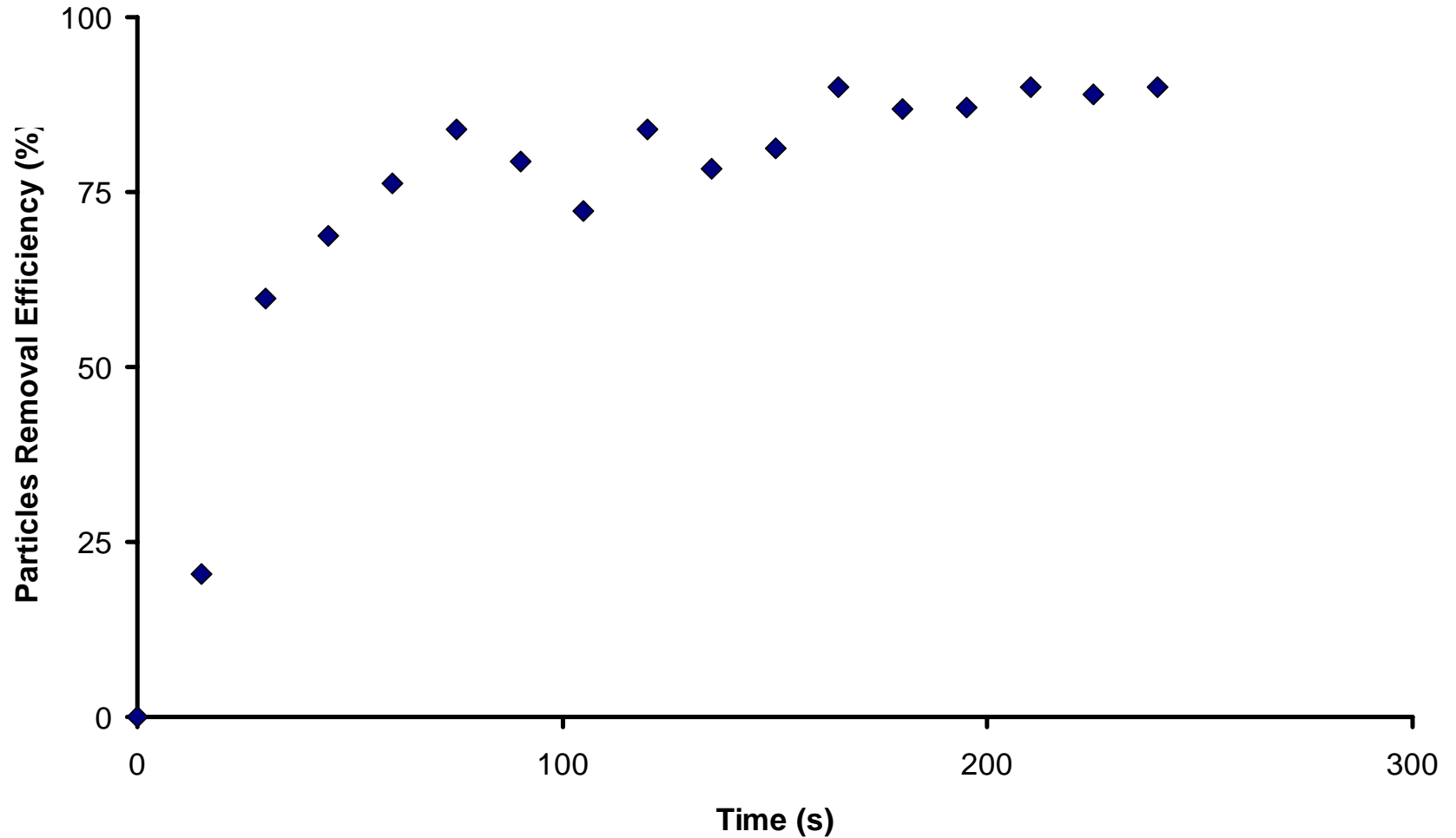


Example: Removal study

Samples : constant interval



Example: Results



Conclusion

- Particle synthesis
 - Silica particles with metal-ion core (>19nm)
 - Detection: Metal-Ion tracer
 - No leaching of metal ion from core
- Removal mechanism
 - An alternative method to use PRE study

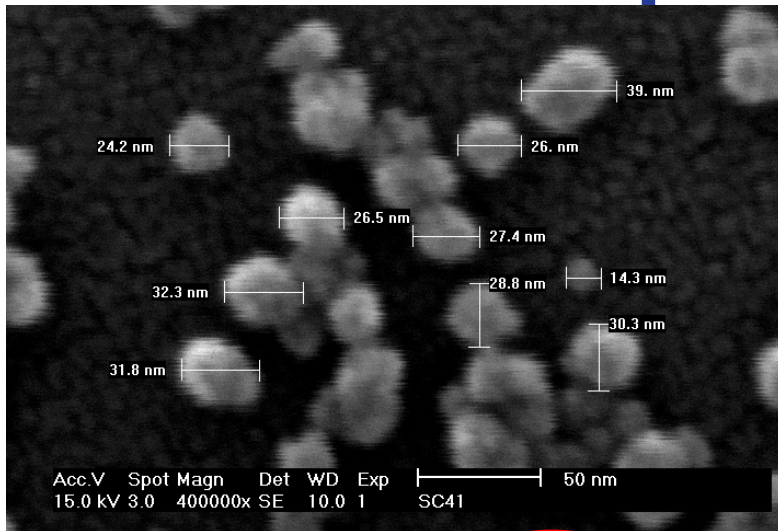
Acknowledgement

- For removal experiments
 - Adrien Maurel (student internship)
 - Roy te Brake (ICP-MS Analysis)
- For financial support

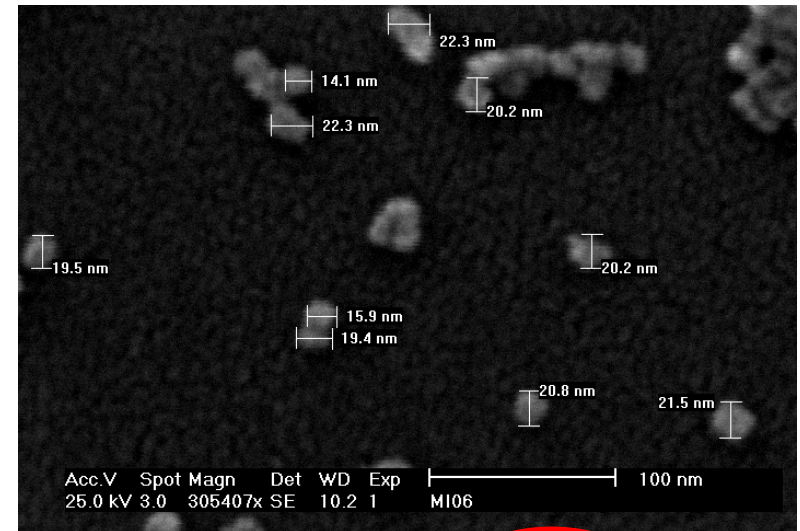


New Slide

Effect of ions on particles properties



SC41: $29,1 \pm 10,8 \text{ nm}$



MI06: $19,6 \pm 2,7 \text{ nm}$

Monodispersity increased!