DANISH TECHNOLOGICAL INSTITUTE

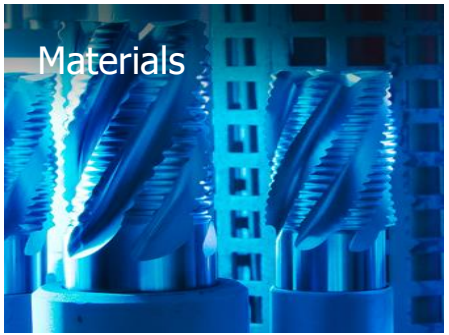
Controlled release of biocides from encapsulation

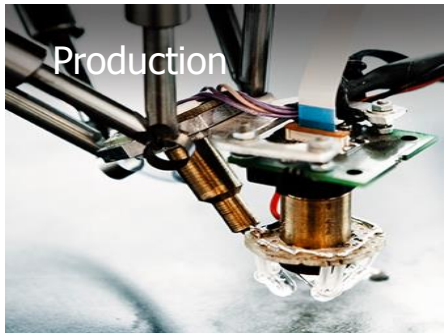
Jeanette S-Eskesen
jse@dti.dk

www.dti.dk

Danish Technological Institute

DANISH TECHNOLOGICAL INSTITUTE





Danish Technological Institute

Expertise:

- Research and development projects in collaboration with university and industry
- Substitution and encapsulation
- Characterisation of particles

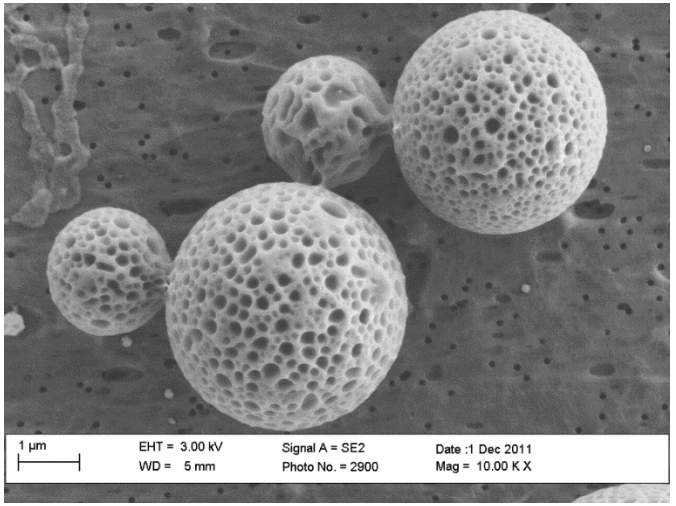
Focus:

- Sustainable materials
- Tailor-made material properties
- Substitution and reduction of problematical chemicals

Project: Encapsulated biocides

DANISH TECHNOLOGICAL INSTITUTE

- Blue INNOship - Partnership with approx. 40 partners
- 15 projects - Activities for app. 16 million EUR



- **Goals and objectives:**
  - Control release rate of biocides in antifouling coating

Blue INNOship

http://www.blaainno.dk/

Antifouling coating – Why and what for?

DANISH TECHNOLOGICAL INSTITUTE

- Biocides are often used in antifouling coatings to prevent fouling

- Balance to have low toxicity and still prevent fouling

Antifouling coating – Why and what for?

DANISH TECHNOLOGICAL INSTITUTE

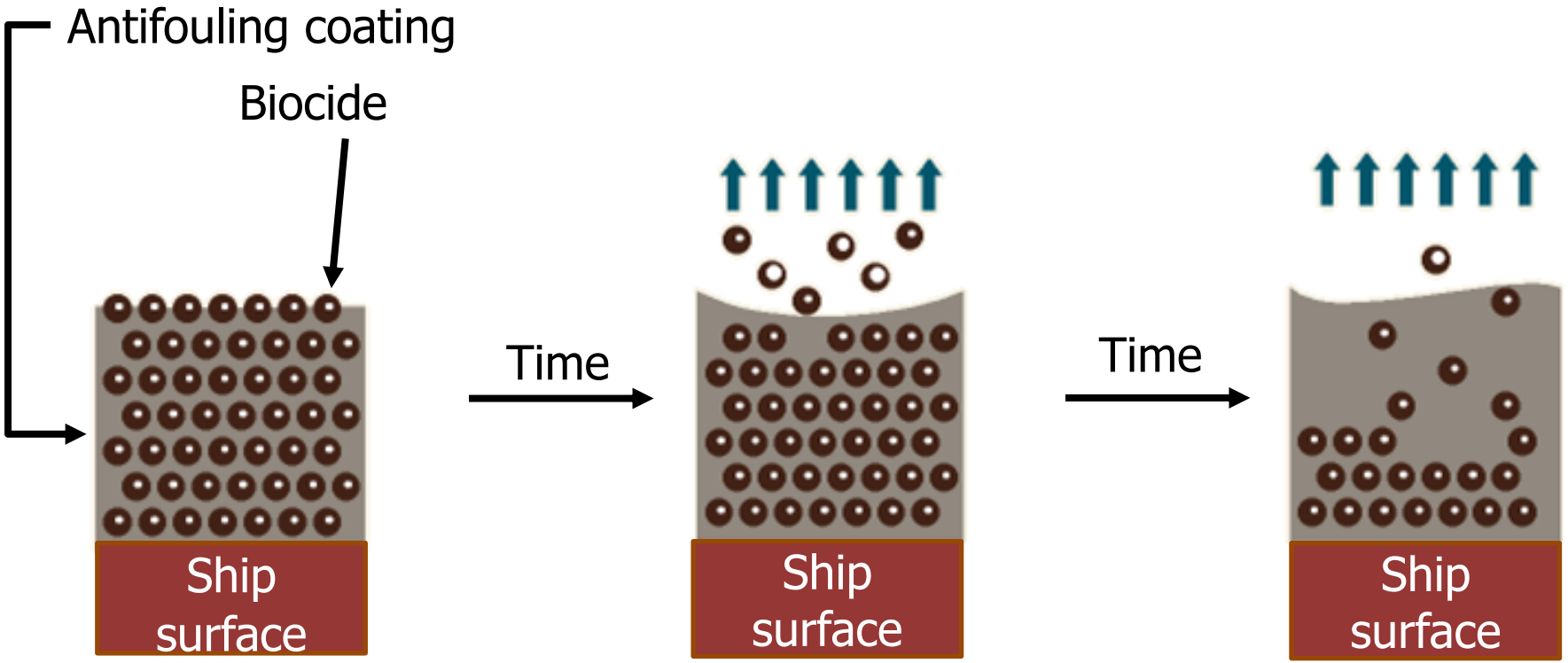
- Fouling is unwanted biological growth on the underwater surface of marine vessels

- Increases drag on the surface:
  - Slime 1-2 %
  - Weed 10 %
  - Hard 40 %

- Benefits of AF coating:
  - Reduced waste emission, fuel, travel

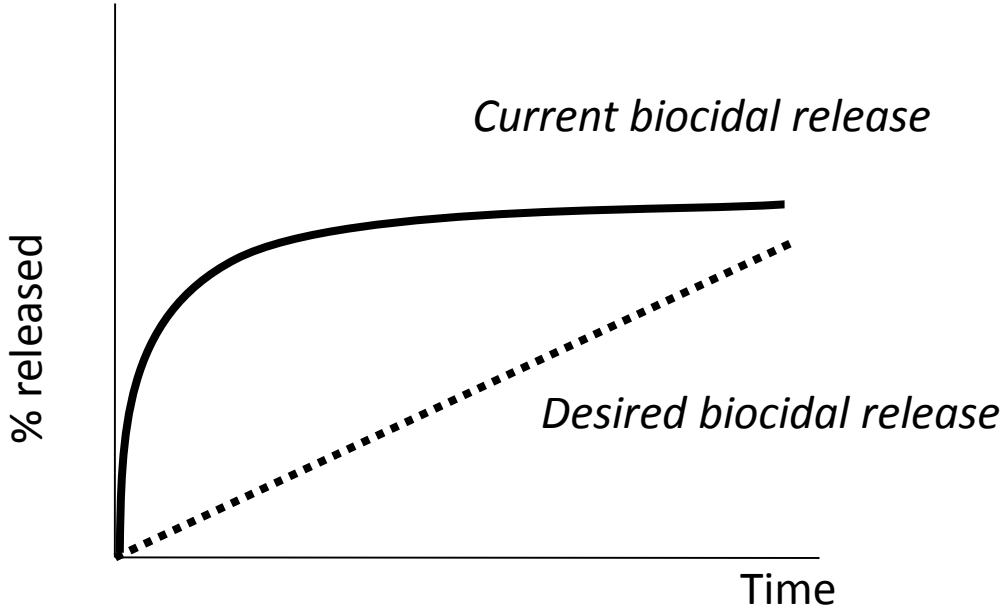
Antifouling coating mechanism

DANISH TECHNOLOGICAL INSTITUTE



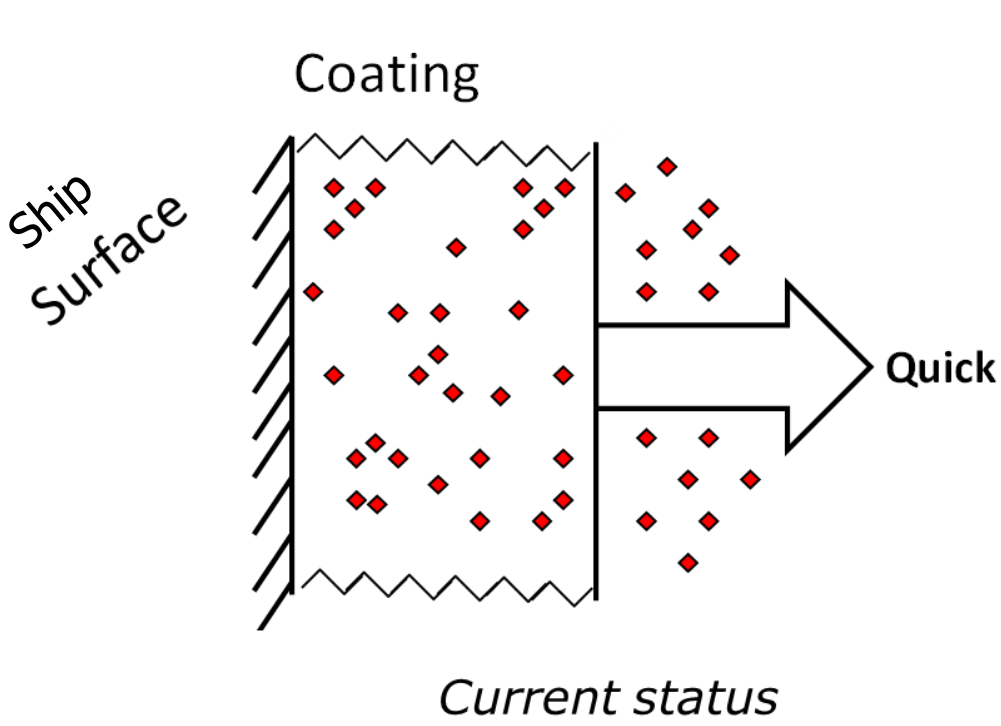
Release of biocides in antifouling coating

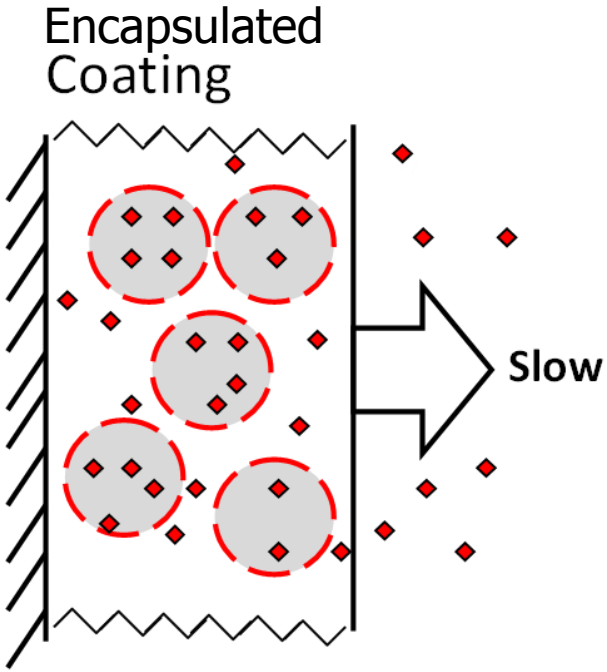
DANISH TECHNOLOGICAL INSTITUTE



Benefits of using encapsulation in antifouling coating

DANISH TECHNOLOGICAL INSTITUTE

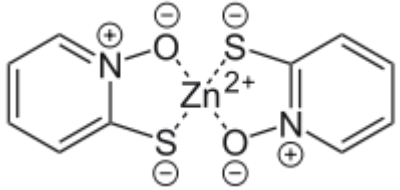




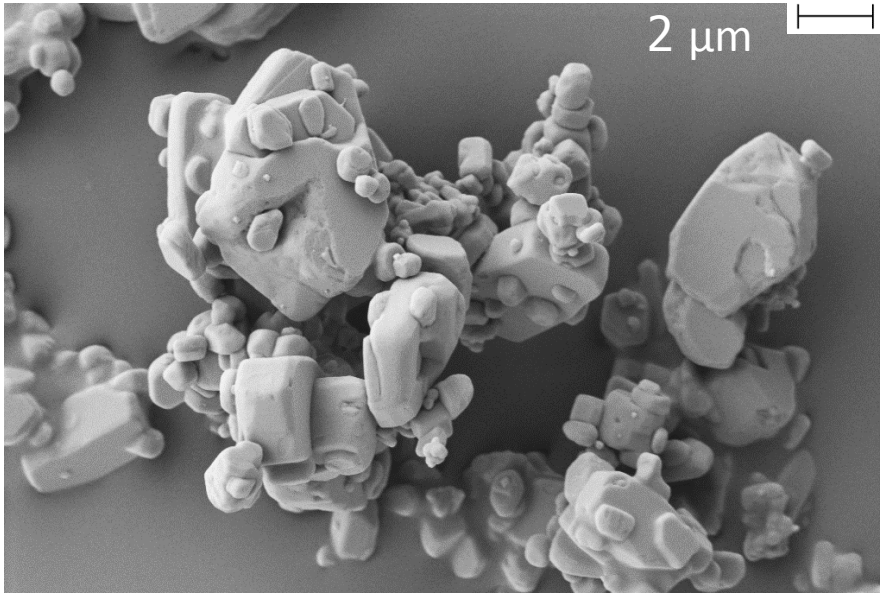
Encapsulated zinc pyrithione

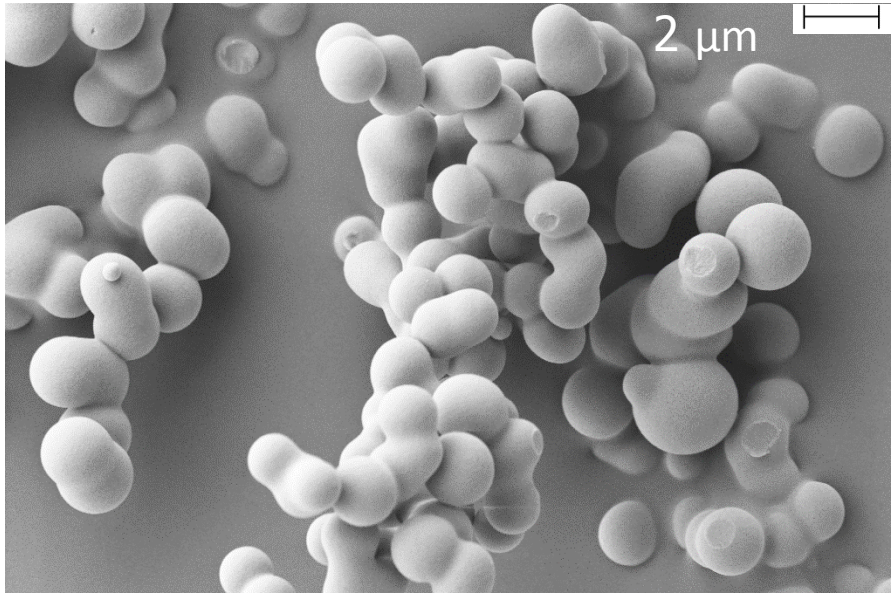
DANISH TECHNOLOGICAL INSTITUTE

Pure Zn-Pt



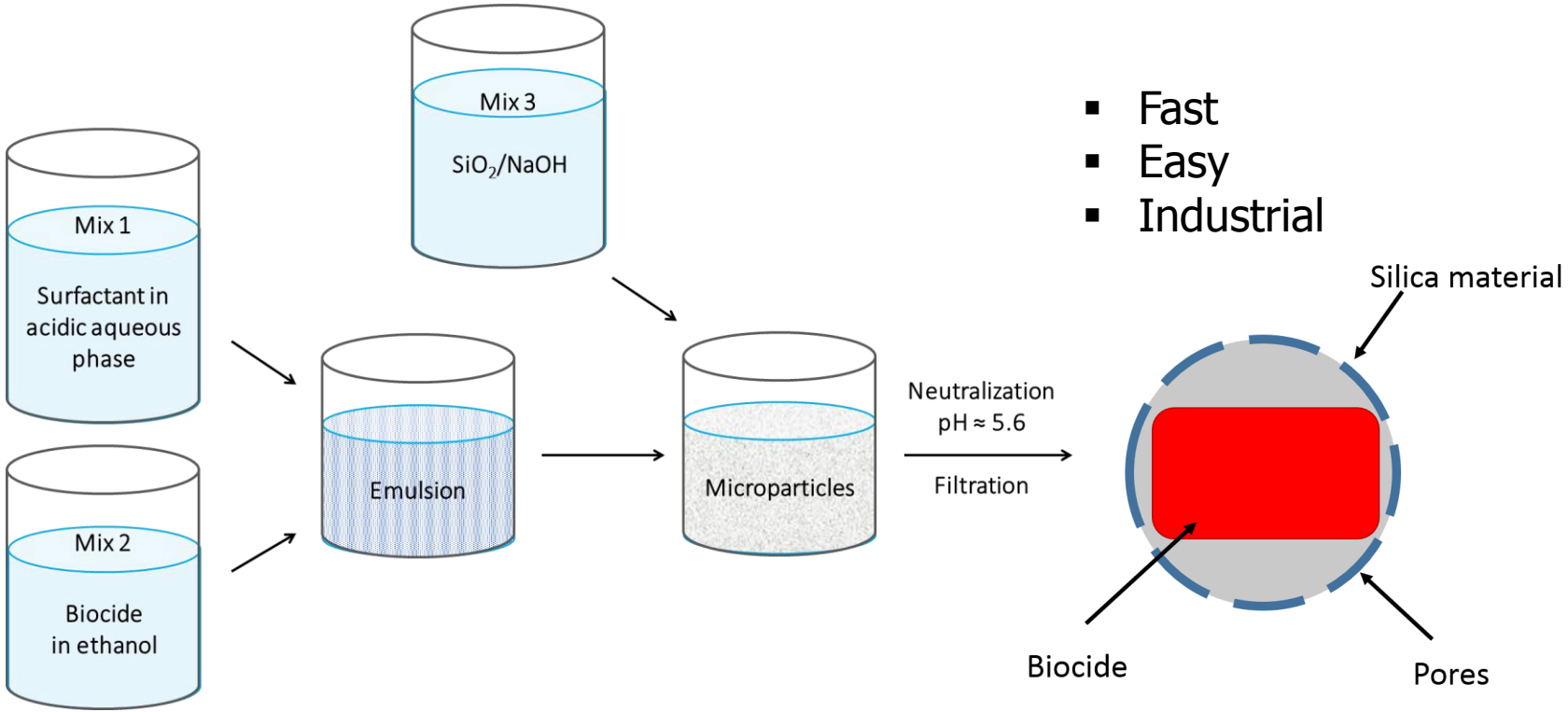
Silica





Synthesis of encapsulated zinc pyrithione

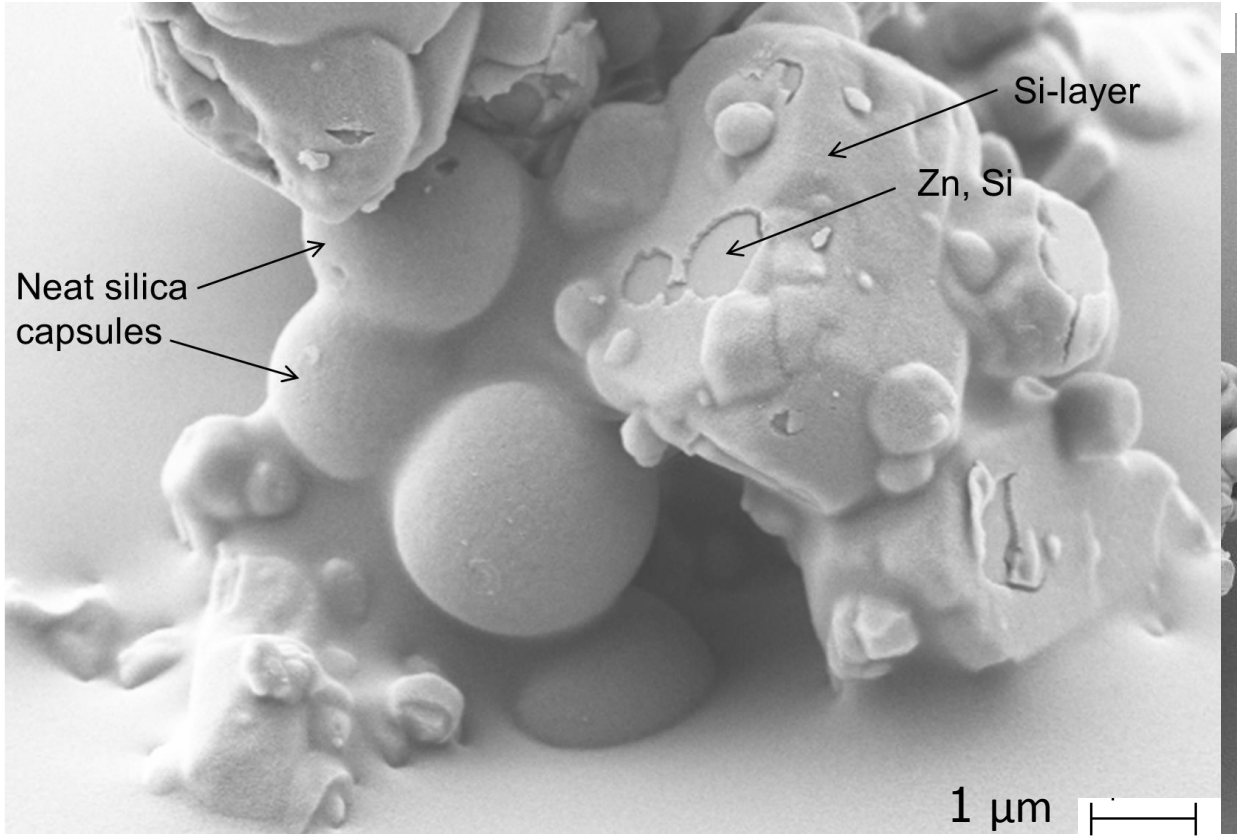
DANISH TECHNOLOGICAL INSTITUTE



- Fast
- Easy
- Industrial

SEM-EDX of encapsulated zinc pyrithione

DANISH TECHNOLOGICAL INSTITUTE



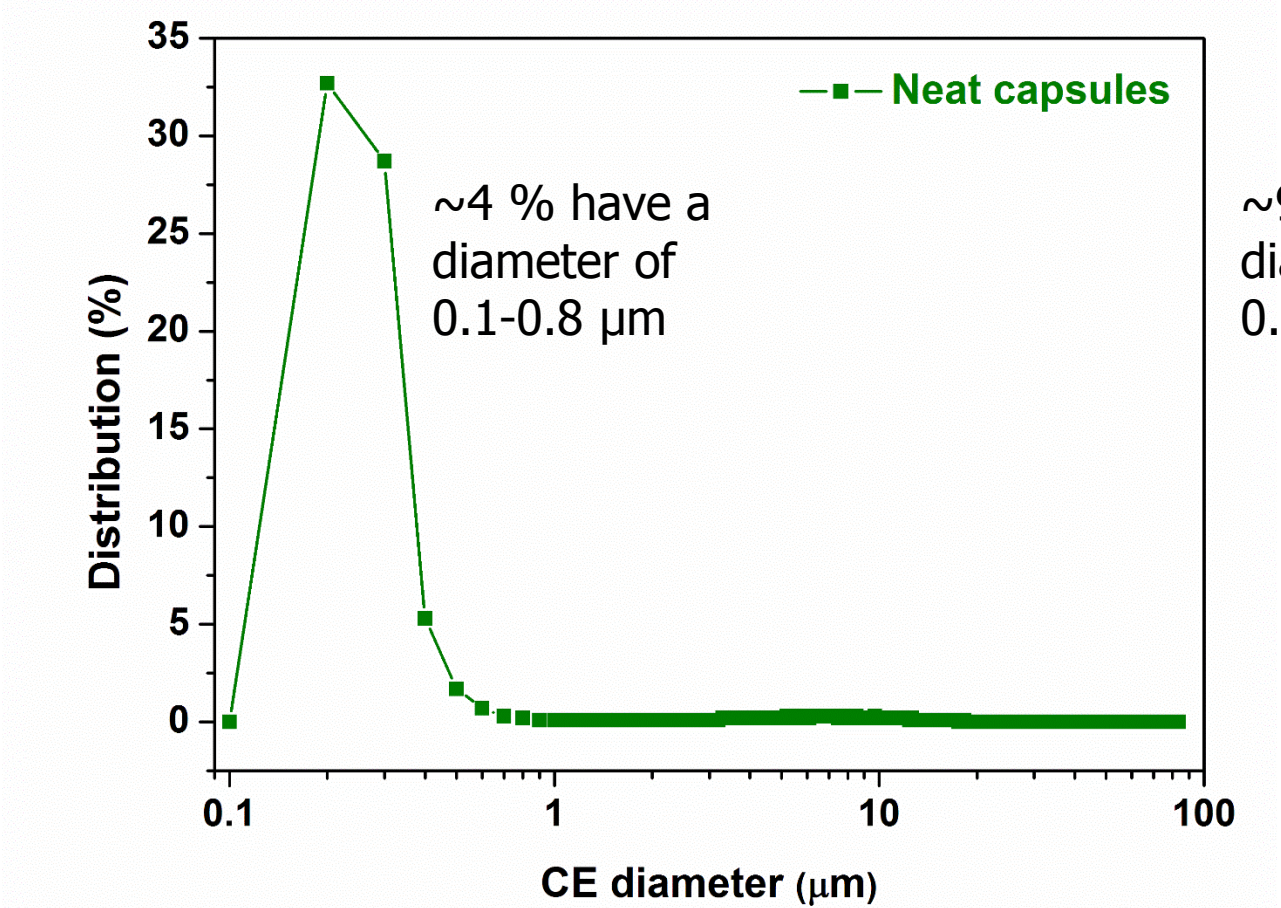
Load of encapsulated zinc pyrithione investigated from ICP-MS

DANISH TECHNOLOGICAL INSTITUTE

	Average weight fraction (%) ± STD
Zinc pyrithione	60±9
Silica	10±2
Silica + zinc pyrithione	70±11
Residual from synthesis	30±11

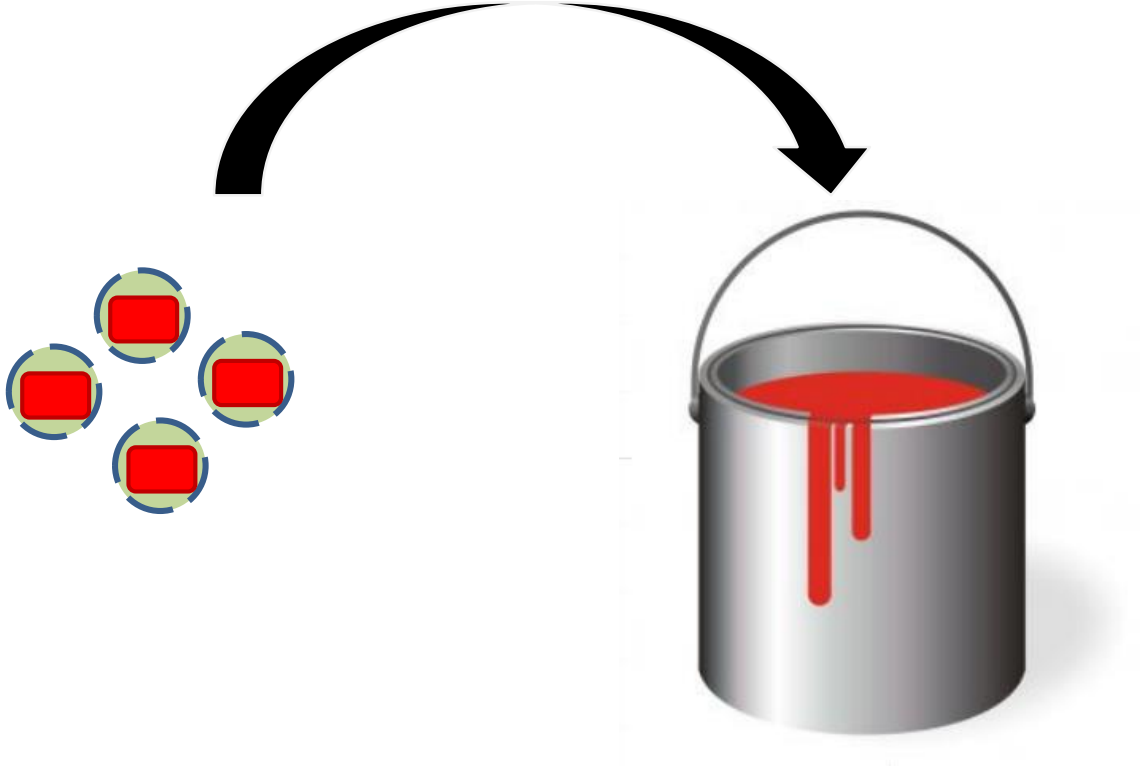
Particle distribution of encapsulated Zn-Pt

DANISH TECHNOLOGICAL INSTITUTE



Incorporating encapsulated Zn-Pt into coating

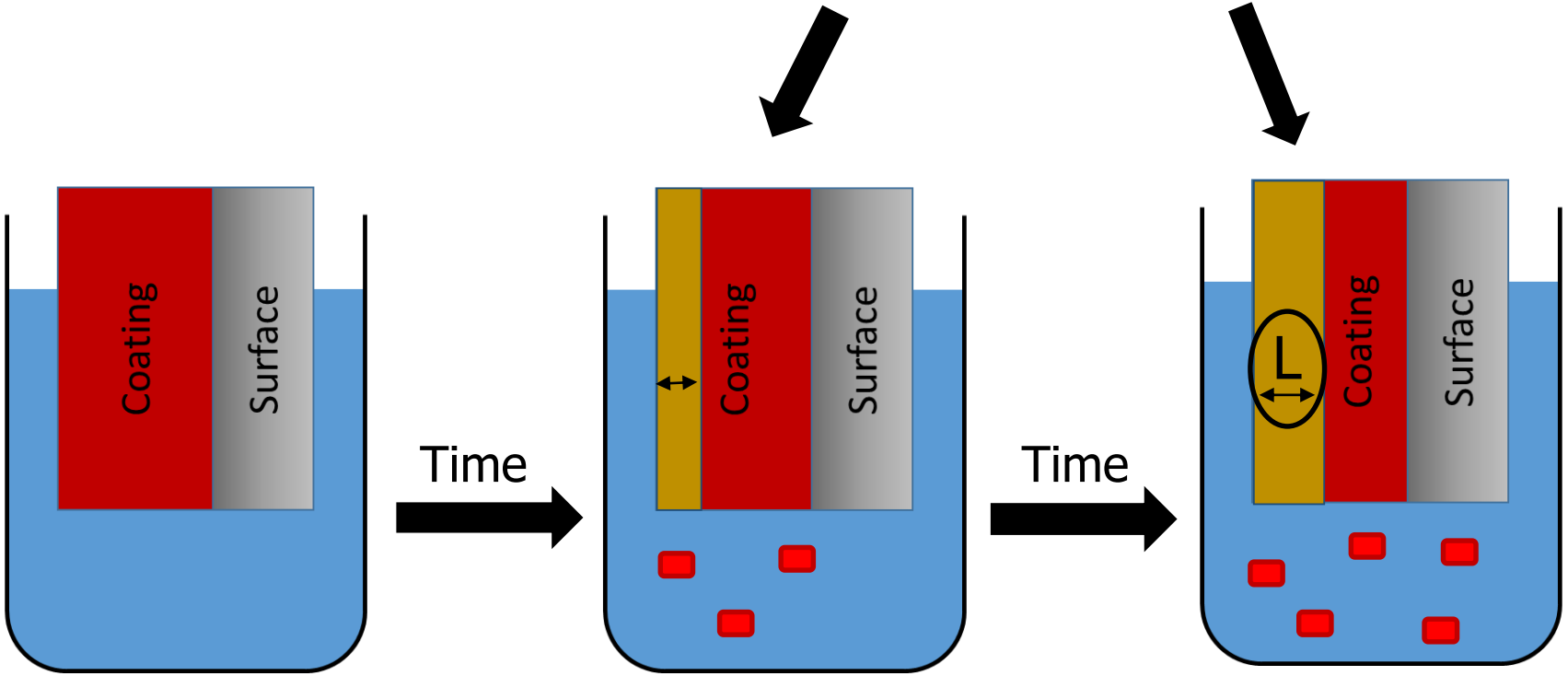
DANISH TECHNOLOGICAL INSTITUTE



Characterization of Zn-Pt released

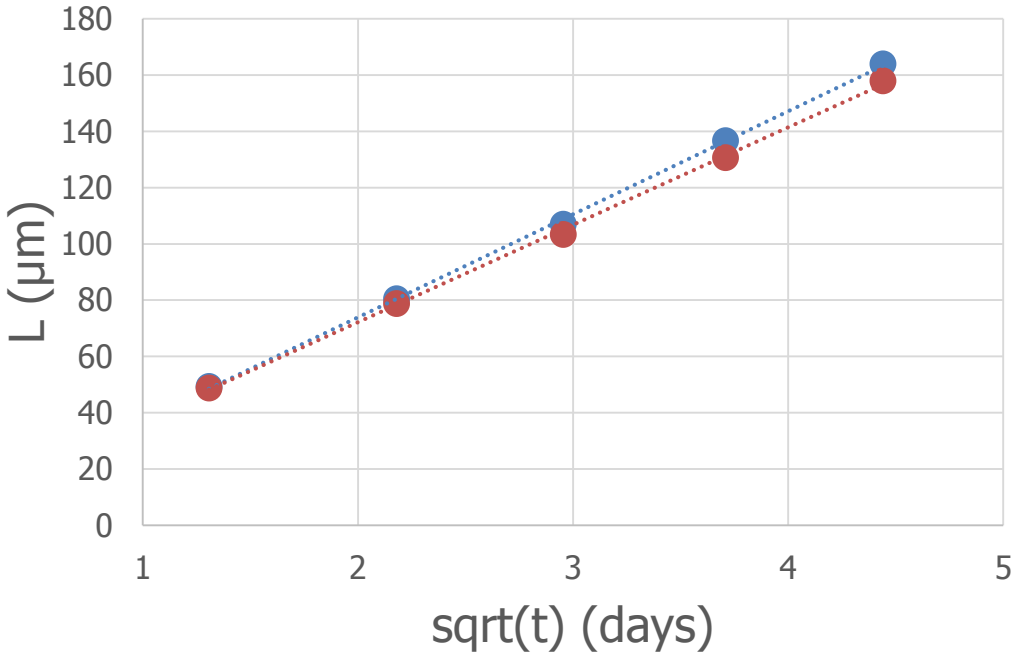
DANISH TECHNOLOGICAL INSTITUTE

Color change due to released biocide



Release experiments from coating film

DANISH TECHNOLOGICAL INSTITUTE



No difference – Two modifications in synthesis!

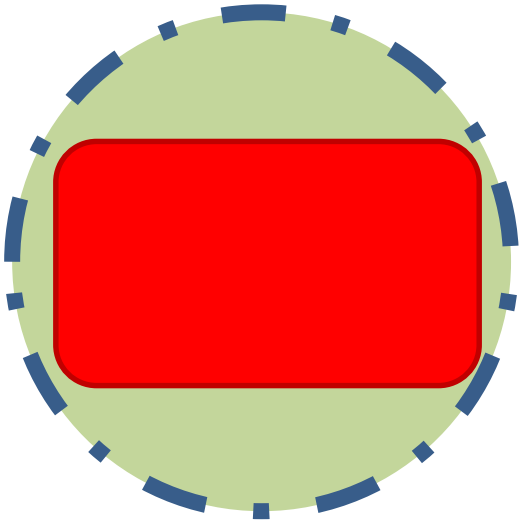
- Denser shell
- Thicker shell

Increased shell density

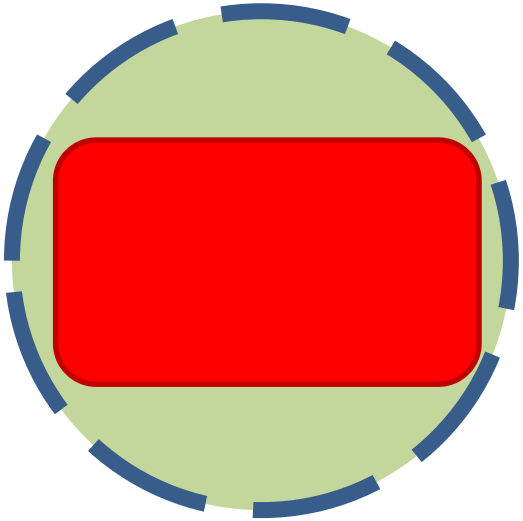
DANISH TECHNOLOGICAL INSTITUTE

- Longer curing = More dense network

3 hours curing



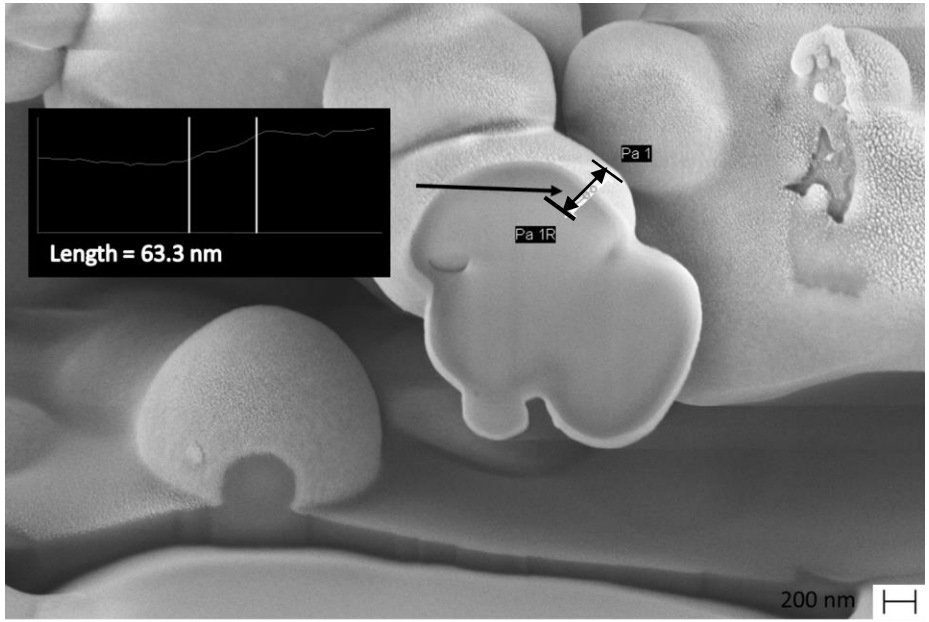
24 hours curing



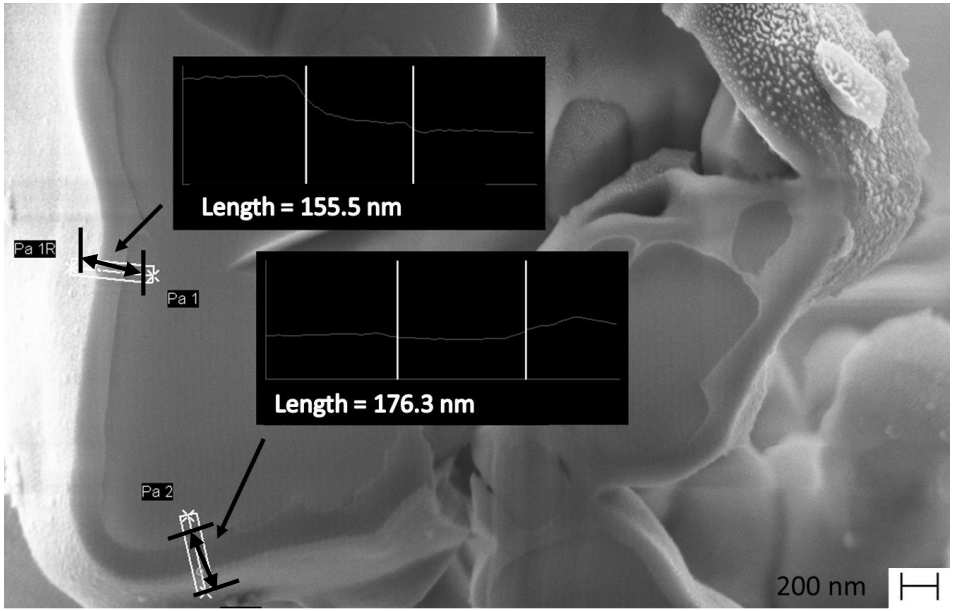
Increased shell thickness

DANISH TECHNOLOGICAL INSTITUTE

- Silica:Zn-Pt 1:1

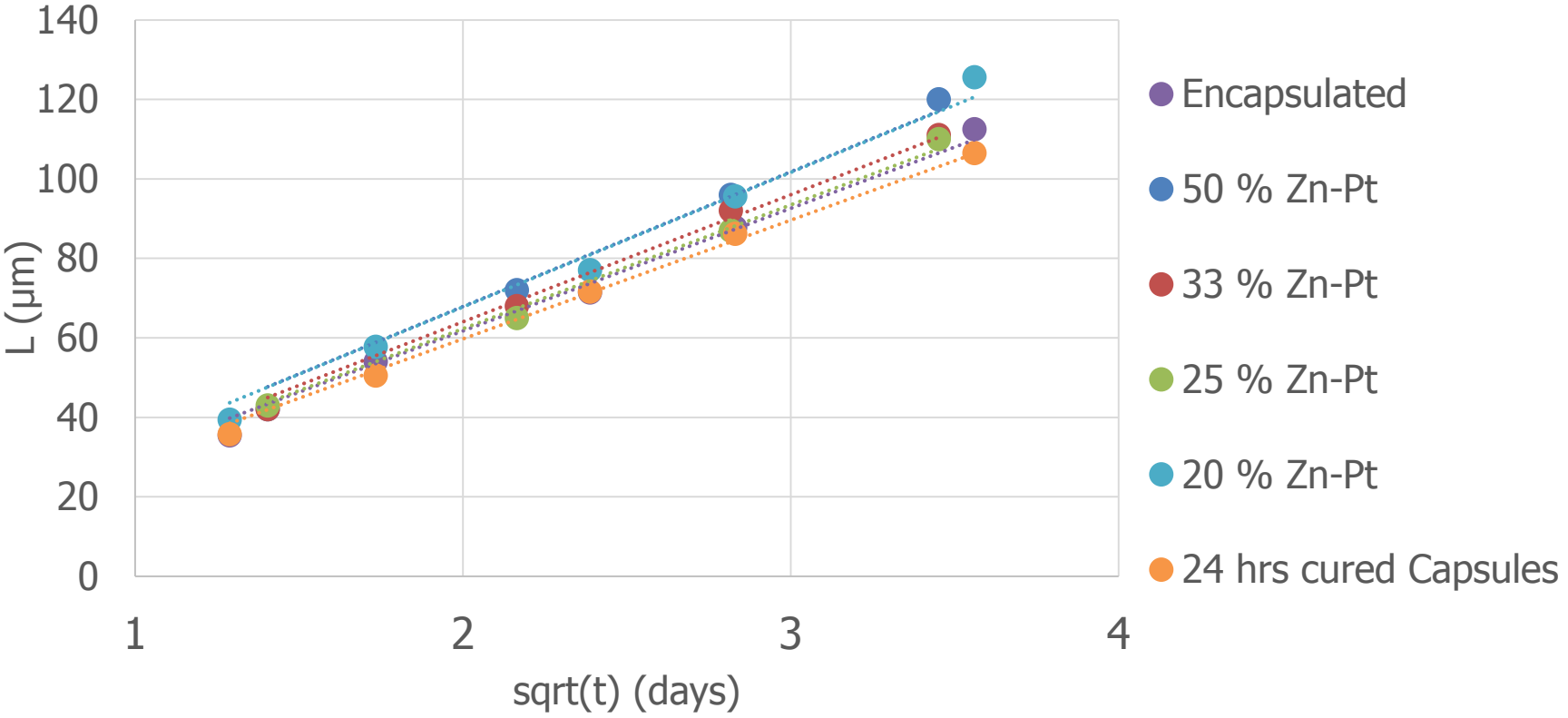


- Silica:Zn-Pt 5:1



Release profiles from coating film II

DANISH TECHNOLOGICAL INSTITUTE



Conclusions

DANISH TECHNOLOGICAL INSTITUTE

- Succesful encapsulation of Zn-Pt
- Possible to alter thickness and density of silica capsules
- Succesful integration into antifouling coating
- No delayed release observed in tested antifouling coating

Acknowledgements

- Lars H. Jepsen, Gitte Tang Kristensen, Mikael Poulsen, and Jens Ravnsbæk, DTI
- Kim Flugt Soerensen and Stefan Olesen, Hempel A/S
- Blue InnoSHIP

Thank you for your time!

Jeanette S-Eskesen - jse@dti.dk
Lars H. Jepsen – laje@dti.dk

www.dti.dk