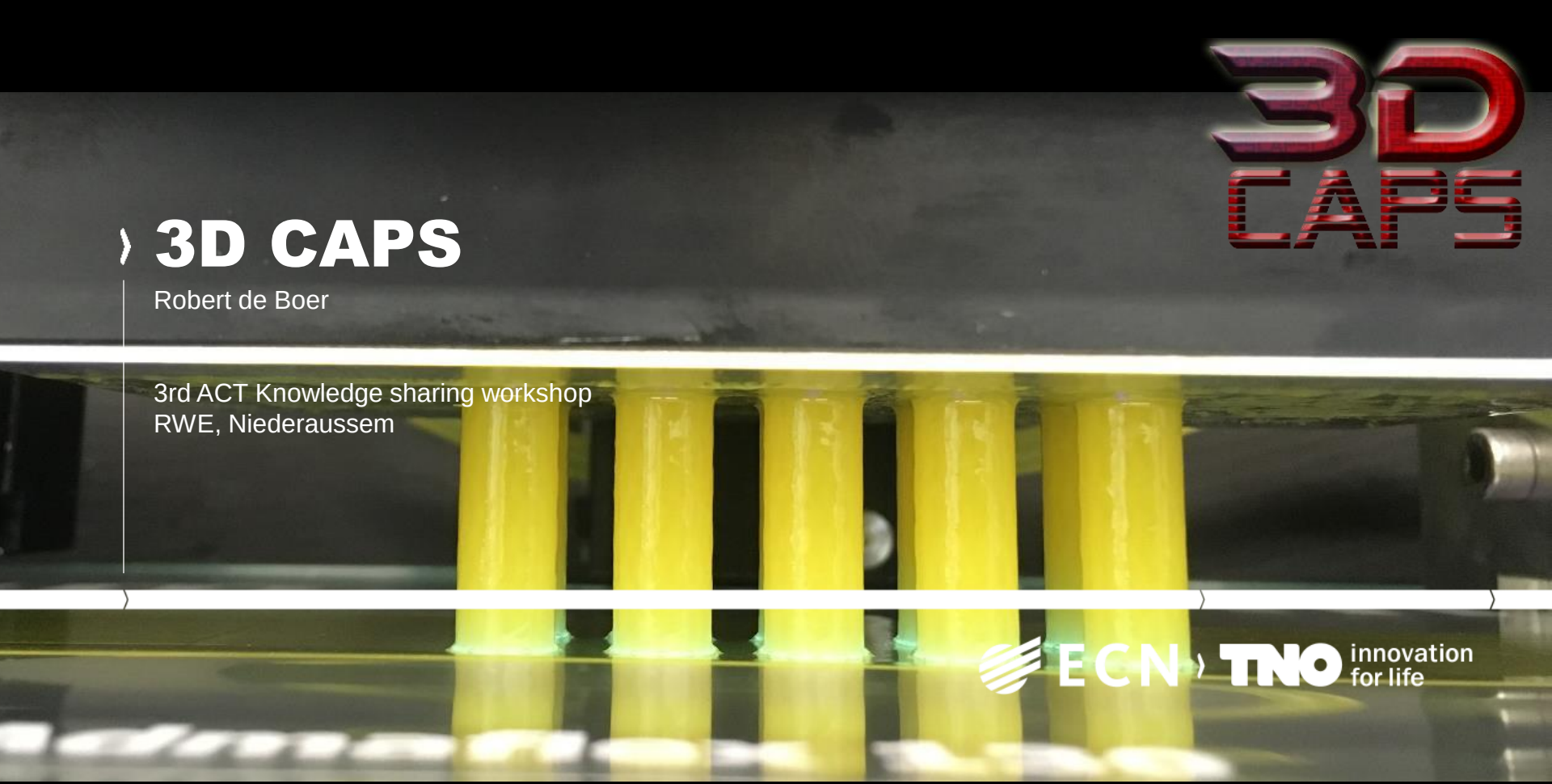


3D CAPS

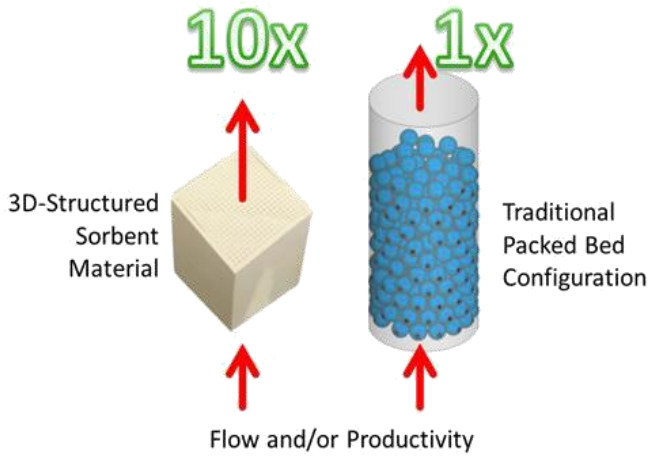
Robert de Boer

3rd ACT Knowledge sharing workshop
RWE, Niederaussem

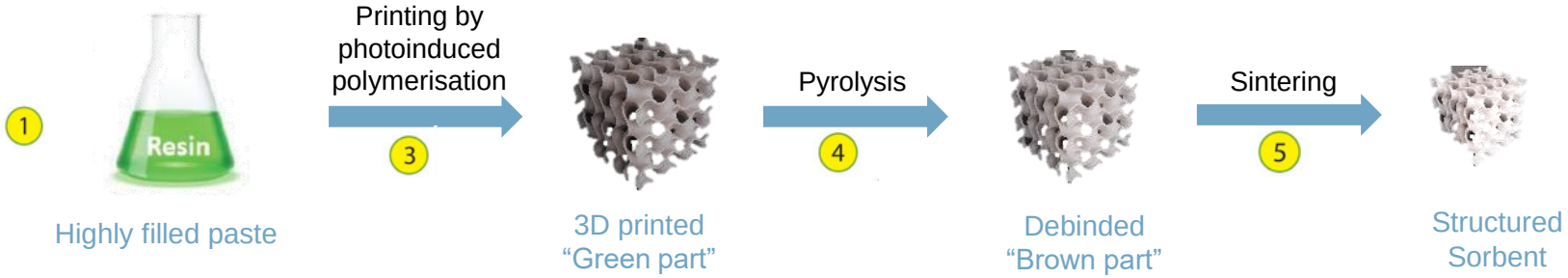
Three Dimensional Printed Capture Materials for Productivity Step-Change

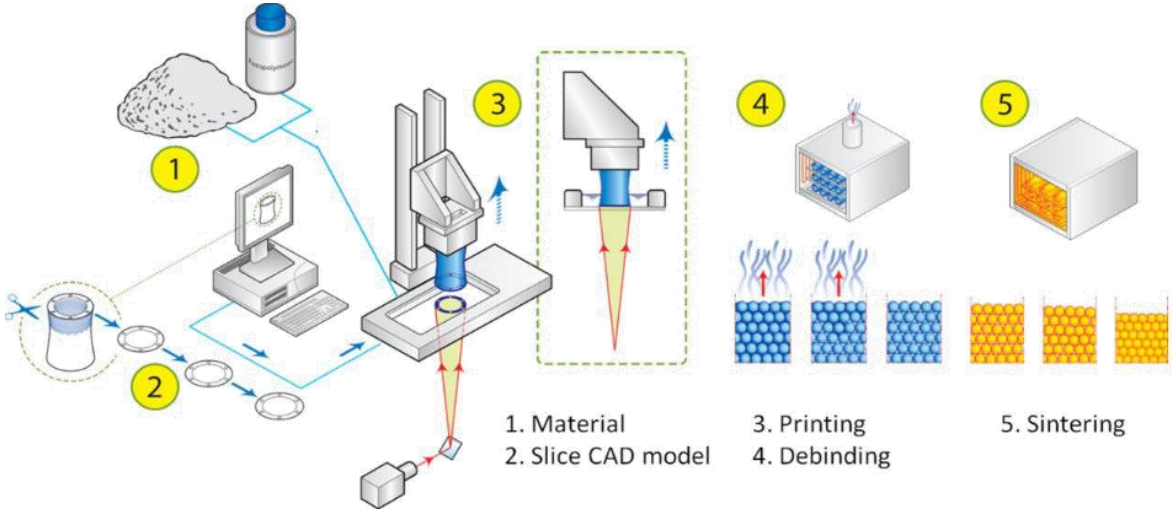
PROJECT AND OBJECTIVES

- Overall objective:
  - Productivity (kg CO_2/m^3hr) increase by factor 10 of sorbent based capture technologies
- Means:
  - Additive manufacturing, 3D-printing
- Materials:
  - Hydrotalcite
  - Amine Functionalised Silica
- Applications:
  - *Post-combustion* capture NGCC power plants
  - *Pre-combustion* capture for H_2

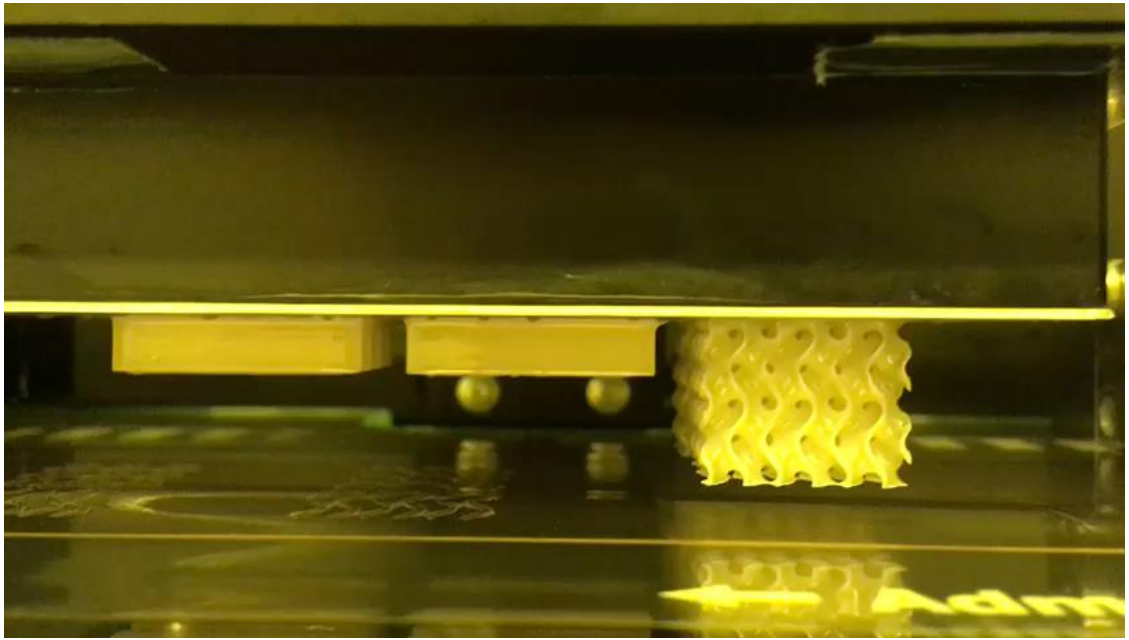


DLP 3D PRINTING



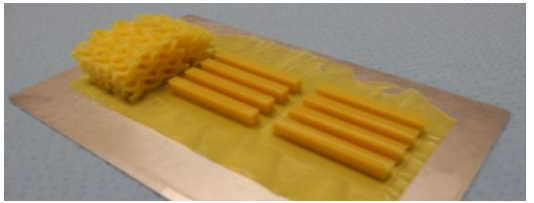


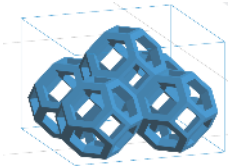
PRINTING AMORPHOUS SILICA

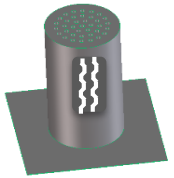


PASTE DEVELOPMENT

- Hydrotalcite status:
  - Printable paste
  - Optimisation ongoing
- Silica status:
  - Printable paste and initial post-treatment developed
    - Shrinkage ~10% upon sintering
    - Sufficient surface area maintained
  - Several 3D structures printed:
    - Iso-reticular foam
    - Cylinder with (zig-zag) channels







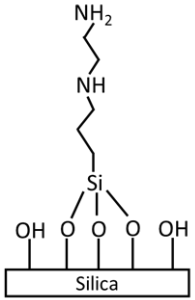
Functionalise

1. Grafting aminosilanes
2. Grafting POSS
3. Impregnation with PEI

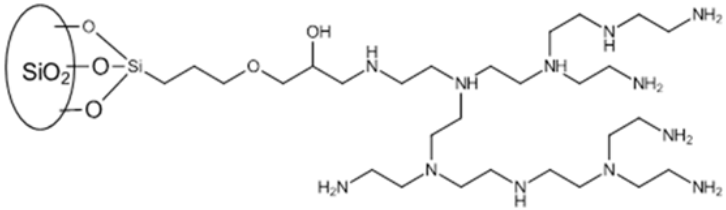
AMINE GRAFTING ON SILICA: ImmoAmmo

Three routes for grafting:

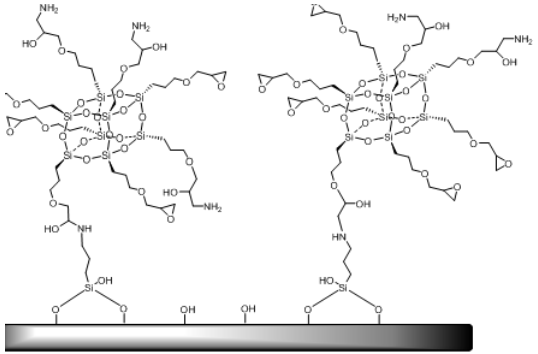
Amino silanes



PEI (Polyethylenimine)

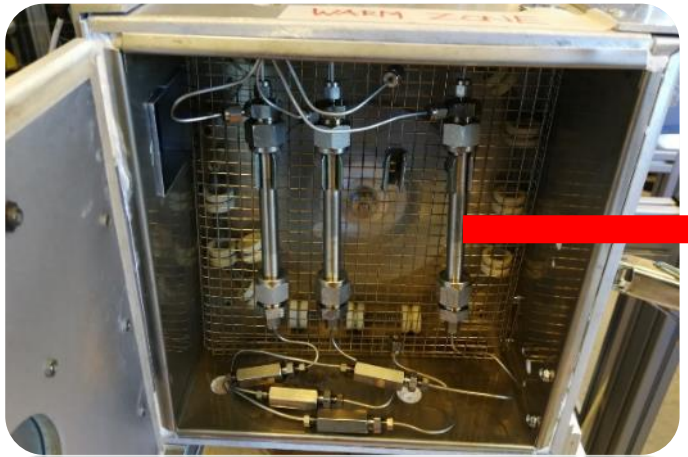


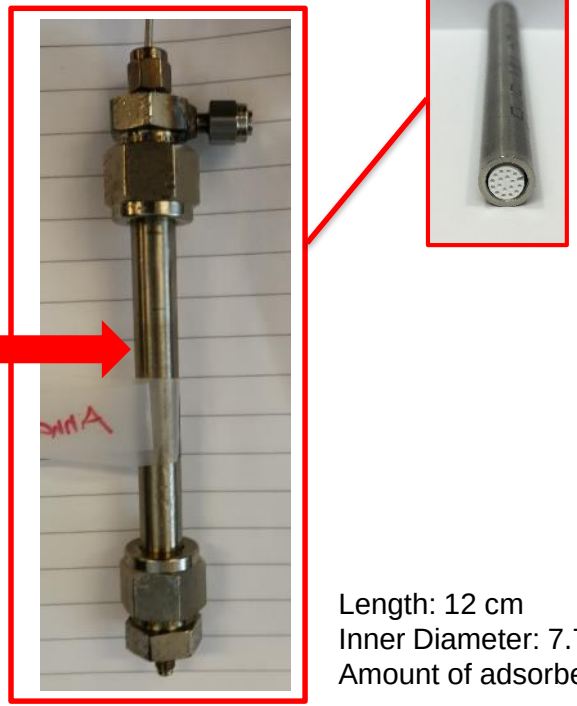
POSS (Polyhedral oligomeric silsesquioxane)



TESTING OF PRINTED SORBENTS

- Adsorption column for ImmoAmmo





Length: 12 cm
Inner Diameter: 7.7 mm
Amount of adsorbent 2-3 g

CO_2 CAPTURE MODELLING

- Computational Fluid Dynamics modelling
  - Optimization of 3D-printed configurations
- Multi Cycle modelling
  - Performance analysis of sorption cycle process with 3D-Sorbents
- Flowsheeting
  - Sorption system integration and TE evaluation

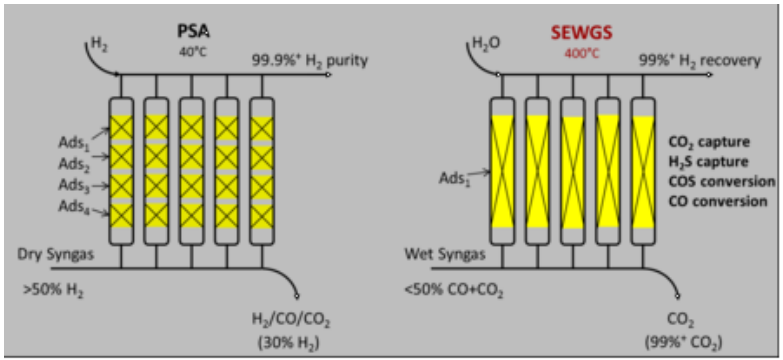
ECN TNO innovation for life

CFD Analysis

Kelvin cell structures

Chemical Engineering Journal

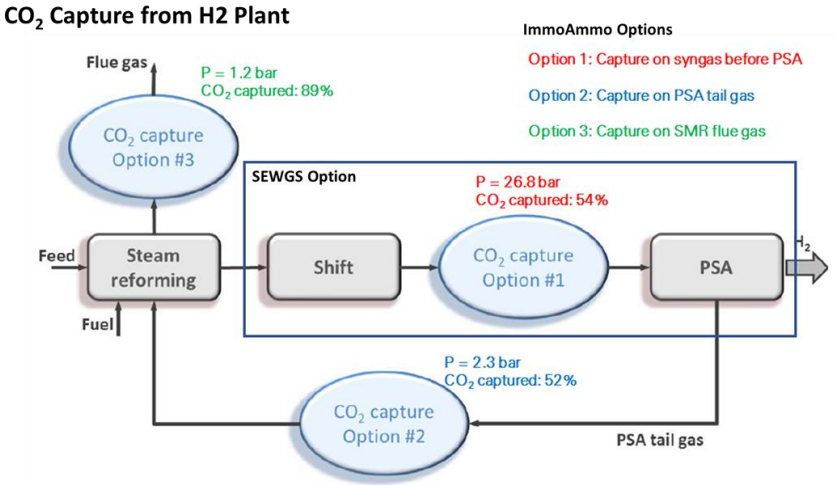
Volume 264, 15 March 2015, Pages 514-521



CO_2 CAPTURE APPLICATIONS

- **ImmoAmmo (SiO_2)**
  1. *Post-combustion* capture for NGCC plants
  2. *Pre-combustion* capture for H_2 production
- **SEWGS (Hydrotalcite)**
  3. *Pre-combustion* capture for **H_2 production**
  4. ~~*Pre-combustion* capture for NGCC plants~~

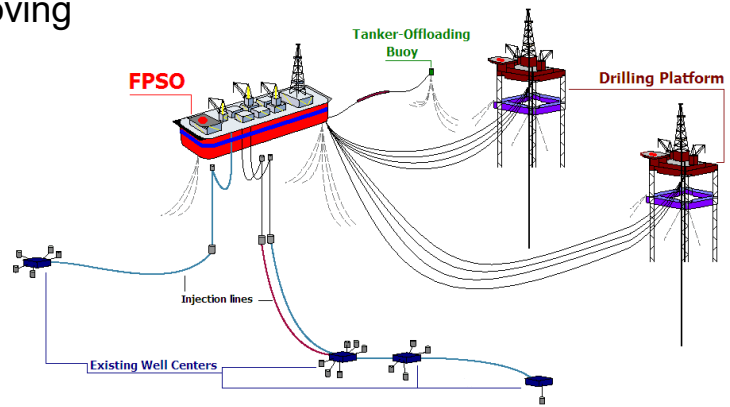
- Quantify costs and performances of:
  - Reference plants (without CO_2 capture)
  - Base cases (CO_2 capture using existing technology, IEAGHG-2017)
  - 3D-CAPS technology



BUSINESS DEVELOPMENT

ACCELERATING CAPTURE TECHNOLOGY

- Initial estimation of total addressable market
- Identify and quantify use cases such as:
  - CO_2 capture from residual steel gases;
  - Offshore CO_2 capture from natural gas production and reinjection;
  - H_2S capture from natural gas production on FPSO's improving safety;
  - … [others still to be identified]
- Preparing for TRL6



- Public Questionnaire *via* https://3d-caps.eu/

ACT KNOWLEDGE SHARING

- Accelerating CO2 Capture technology
  - 3D CAT: start-up company involved for business development,
  - Discussions with CCP partners (end-users), EPC contractor.

- Collaboration/communication
  - F2F progress meetings 6Months
  - Telco Progress: 3Months
  - Frequent WP-meetings / telco
  - Staff exchange

- Synergies with other ACT projects
  - Elegancy (residual steel gas applications)

PROGRESS MEETINGS

- 2018 November 22-23, UBB, Cluj, Romania
- *anticipated*
  - *2019 June, BP, London, UK*
  - *2019 November, TNO Petten, Netherlands*

Acknowledgements

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