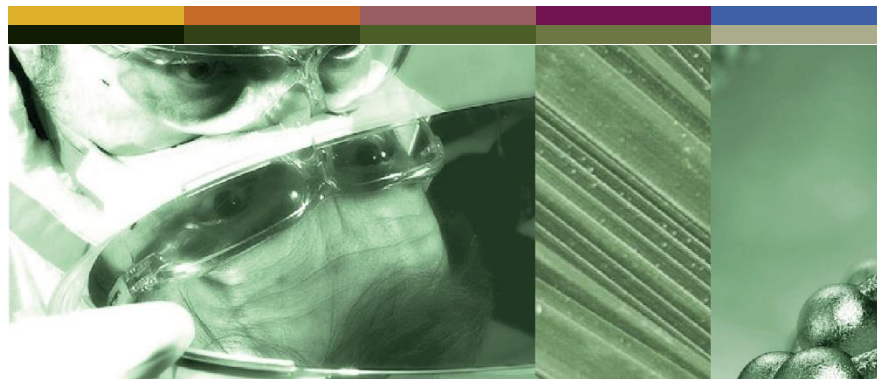


nano SAFE'16

NAWA™ TECHNOLOGIES

NANO MASS PRODUCTION - SAFE BY DESIGN

JÉRÔME SEGARD





1.

NAWATECHNOLOGIES' PROCESS FLOW

2.

FACING THE UNKNOWN – SAFE BY DESIGN

3.

NANOSAFETY MEASURES BY NAWA

4.

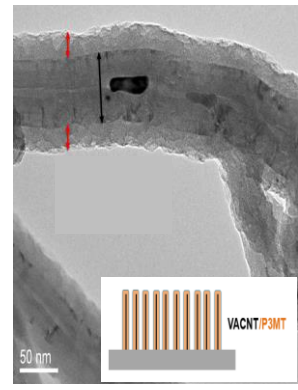
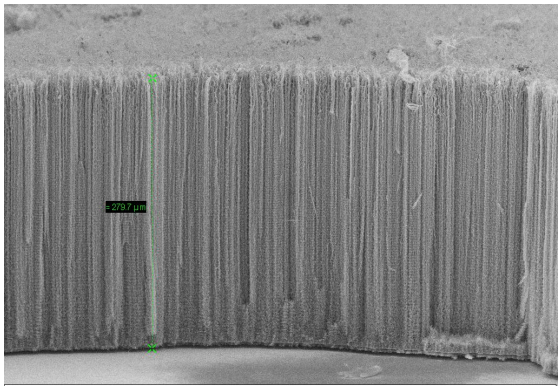
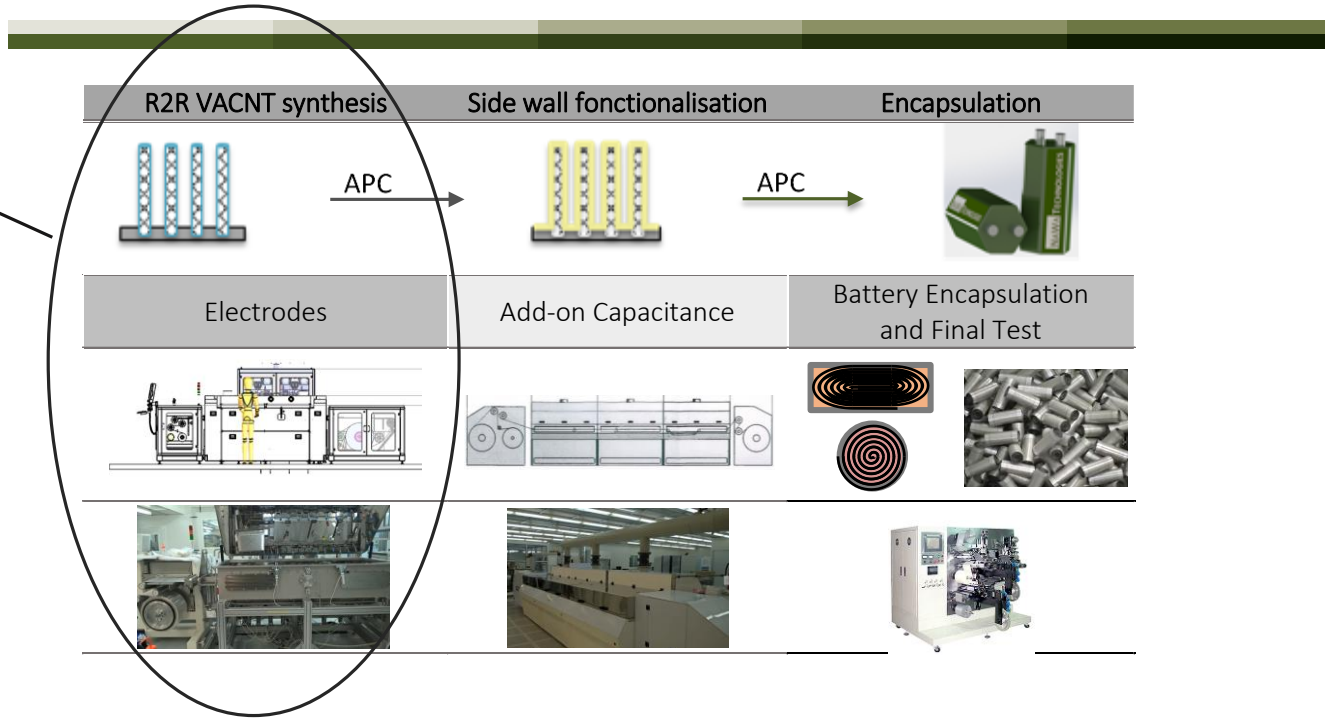
PARTICLE EMISSION, MEASUREMENTS

5.

OUTLOOK

NAWATECHNOLOGIES PROCESS FLOW

Source of nano particles

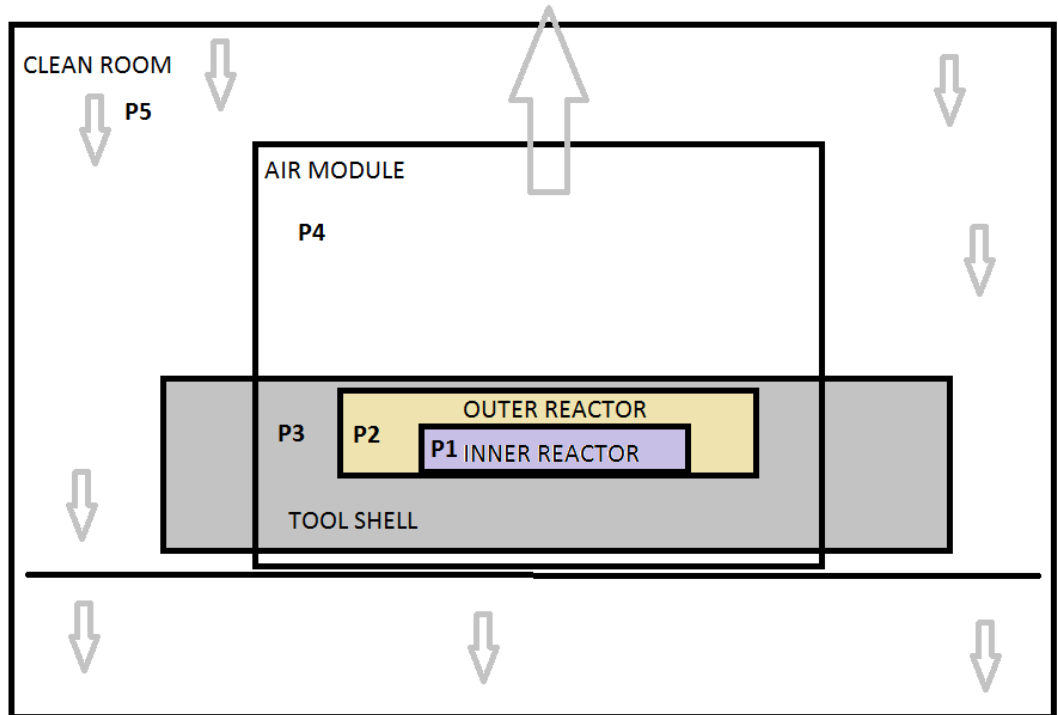


- 2 front end steps (electrode formation)
- 1 back end (encapsulation)

FACING THE UNKNOWN – SAFE BY DESIGN

5 cascades - from the emission point to the work environment

- P1: inner reactor = particle source
- P2: outer reactor
- P3: equipment shell
- P4: air module
- P5: clean room



- Additional design target = flow laminarity

ADDITIONAL NANOSAFETY MEASURES BY NAWA

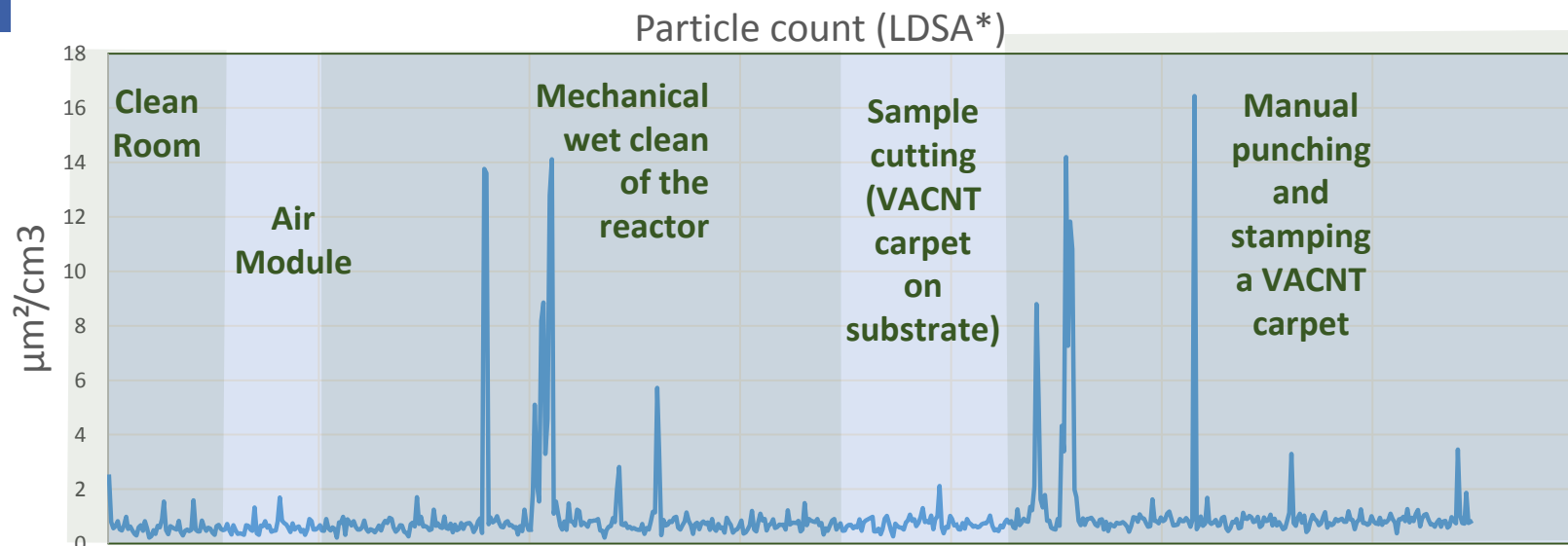
	Inner Reactor	Outer Reactor	Air module	Surrounding Cleanroom
Dry clean	✓		✓	
Breathing Apparatus			✓	
Delta P	✓	✓	✓	✓
HEPA filter			✓	✓
Electrostatic	c o n f i d e n t i a l			

Beyond pressure cascading

- Design takes into account
 - Operator and maintenance activities
 - In situ cleaning technology
 - Filtering and protection



PARTICLE MEASUREMENTS



Lessons Learned

- Emission below background for standard operations
- Clean Room and Air Module always particle free
- Only direct, manual treatment of VACNT emit particles
- VACNT with carpets stick together and VACNTs stick on carpet

Open Questions

- What should be the threshold ?
- Measurement validity for non-spheric particles ?
 - LDSA assumes spherical particles
 - VACNT: 10nm wide, 100 μm long



SUMMARY & OUTLOOK

- Nawa is the first player, worldwide to massproduce VACNT on a R2R basis



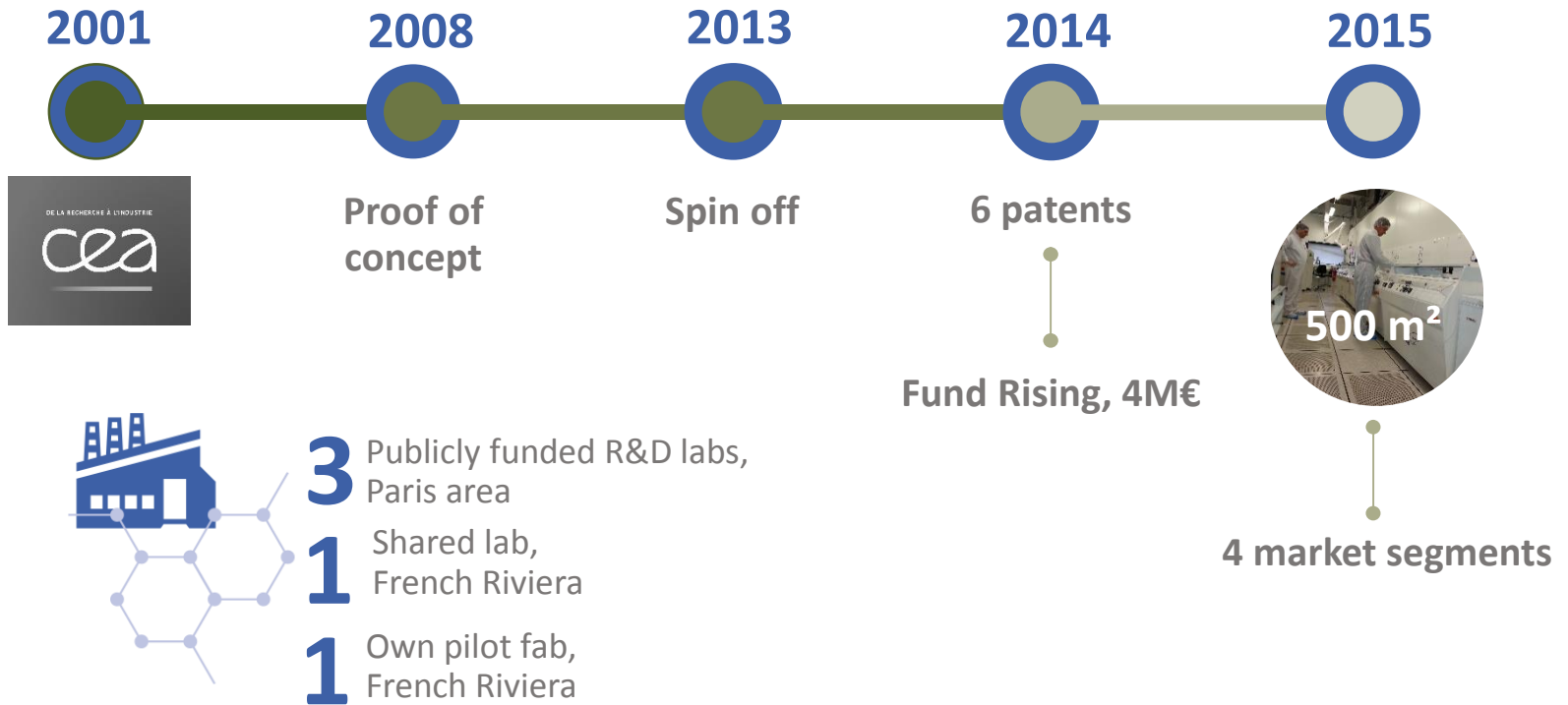
- Others will certainly follow, many applications are ready for industrial investments
- The safe-by-design approach is sufficient, but is an investment overkill
- The Safety Community can help to foster growth, in France, in EU and worldwide

1. Providing reliable, in-situ measurement technologies
2. Defining thresholds



Both need to take into account the topology of nano-structures

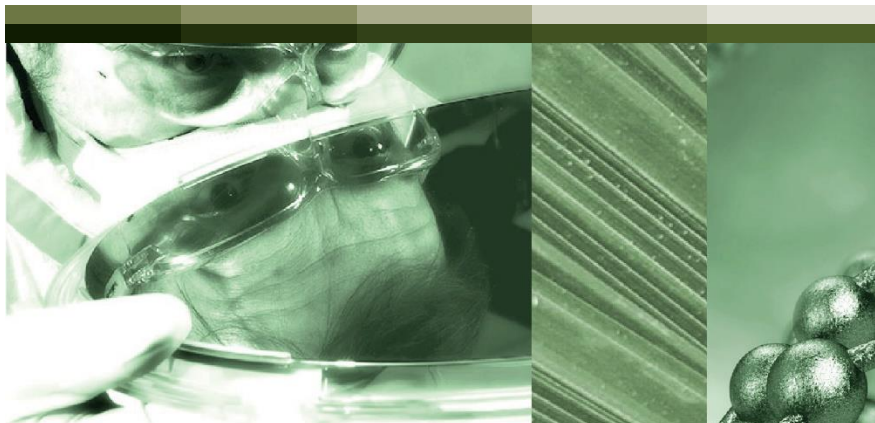
Thank you for your attention



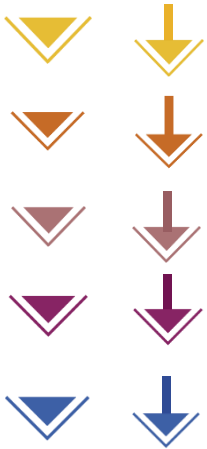


JÉRÔME SEGARD

jerome.segard@nawatechnologies.com



FLÈCHES



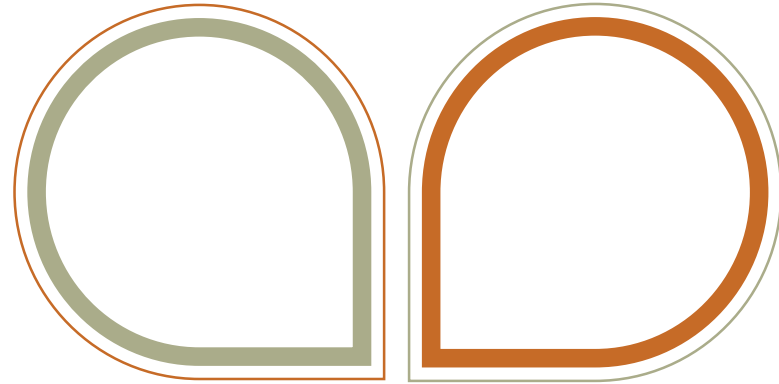
PUCES



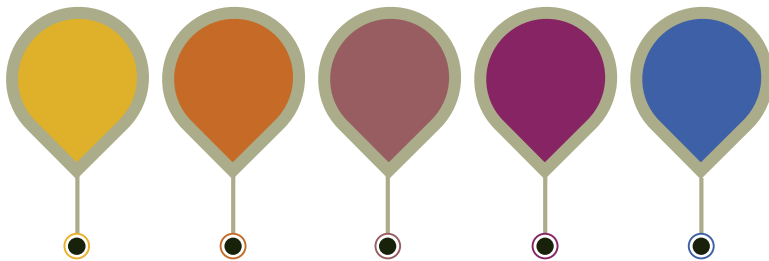
HABILLAGE



EXEMPLE D'HABILLAGE INTERCALAIRE



TIMELINES



PICTOS

