Spatial Atomic Layer Deposition: a Swiss knife for materials science

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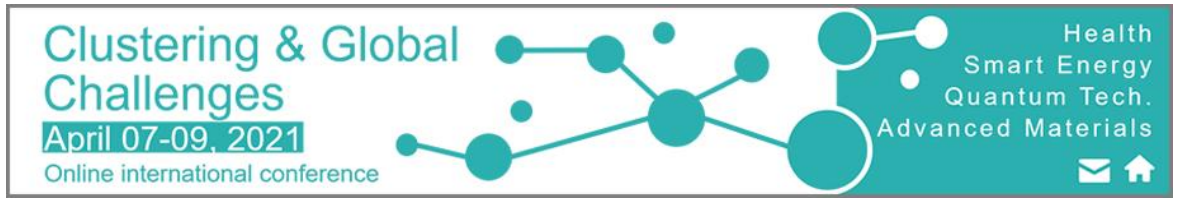
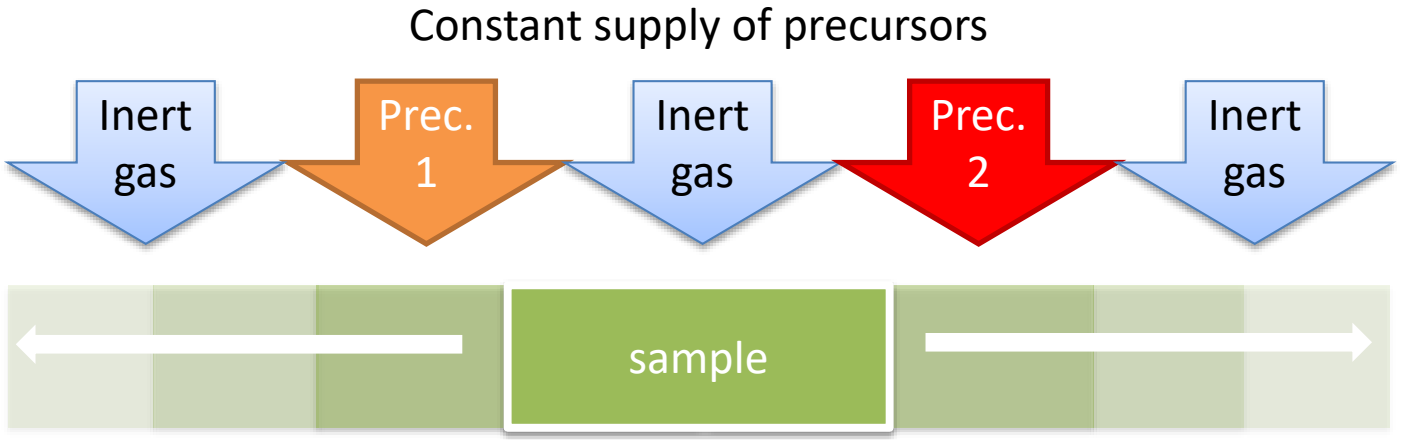


Introduction: Spatial Atomic layer Deposition (SALD)

Key feature of SALD: Precursors are separated in space, not time.
Continuous injection of precursors in different locations



Moves between diff. precursor regions

Thickness control, edge coverqe and high quality at low T

Advantage compared to other deposition techniques:
Faster, atmospheric pressure, even open-air

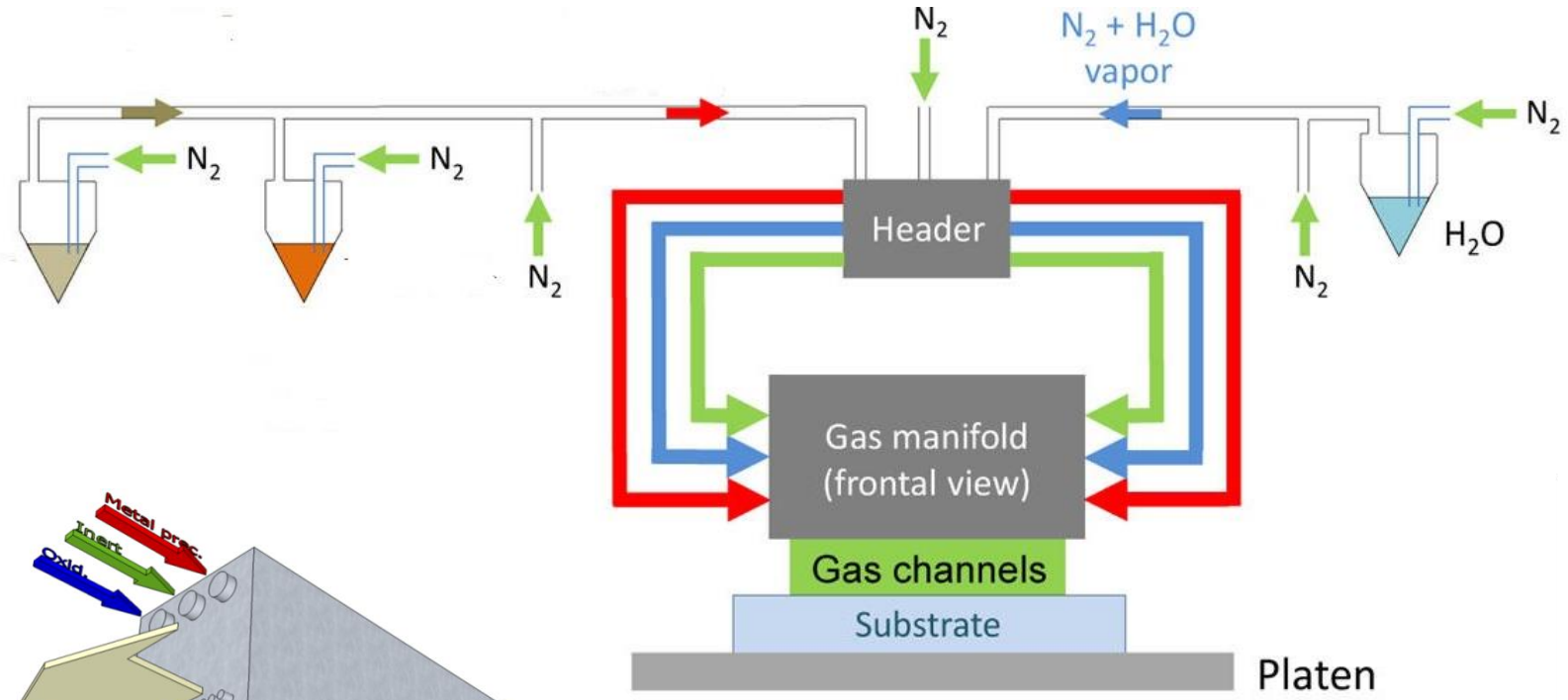
Low-cost applications, high throughput

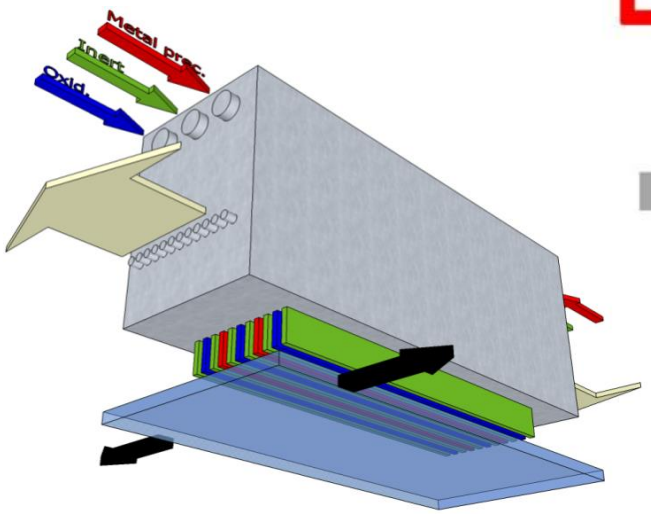
DMR, Mat. Horizons, 2014, 1, 314.

Mat. Today Chem., 2019. Spatial Atomic Layer Deposition, Intechopen, 2019

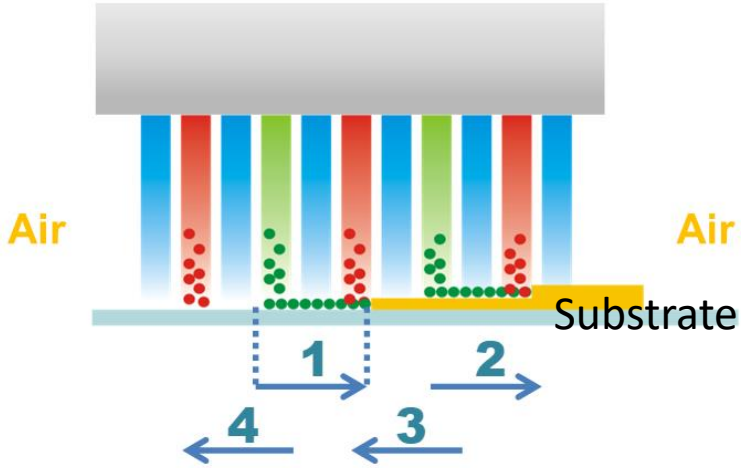
Open-air SALD at LMGP

Based on a close-proximity, manifold injection head





Processing in the open air, no chamber, Simpler, cheaper to scale up



Moves between diff. precursor regions

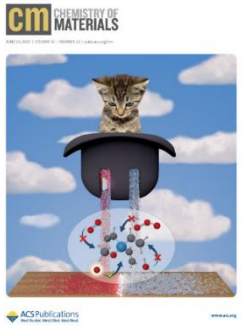
SALD Research at LMGP

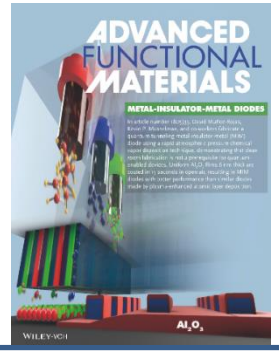
SPECIFICATION OF THE SALD	
Deposition Temperature	RT to 350 °C
Deposition Area	1 to 25 cm^2
Growth rate	Up to 2 nm/Cycle
Subtrates	Metal, glass, plastic, tissue,
Maximum Achievable Thickness	Up to several µm

Materials available or in study:
ZnO, Al_2O_3, Al:ZnO, Cu, Cu_2O, CuO, TiO_2, SiO_x, MgO, SnO_2, Ga_2O_3, HfO_2, Ag, Hybrids

BRAND NEW Pd, BZY, 8YSZ, CeO2

ALD4MEM

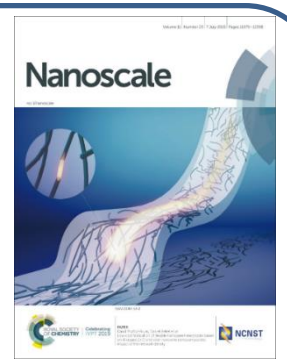




Design & Optimization
- Atm. Plasma activation
- up-scaling/simulation

Fundamental studies
- Effect of open-air processing
- New materials

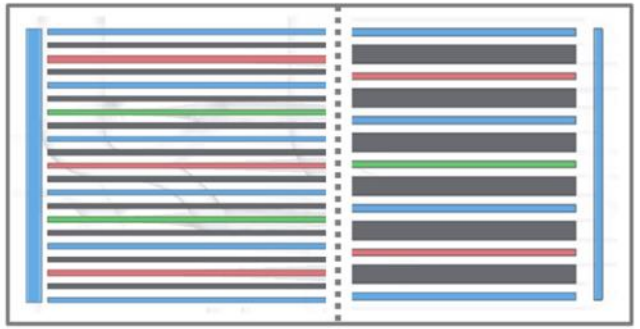
Applications
- TCM
- PV
- Sensors
- Res.Switc.
- Membranes
- Fuel cells / electrolyzers

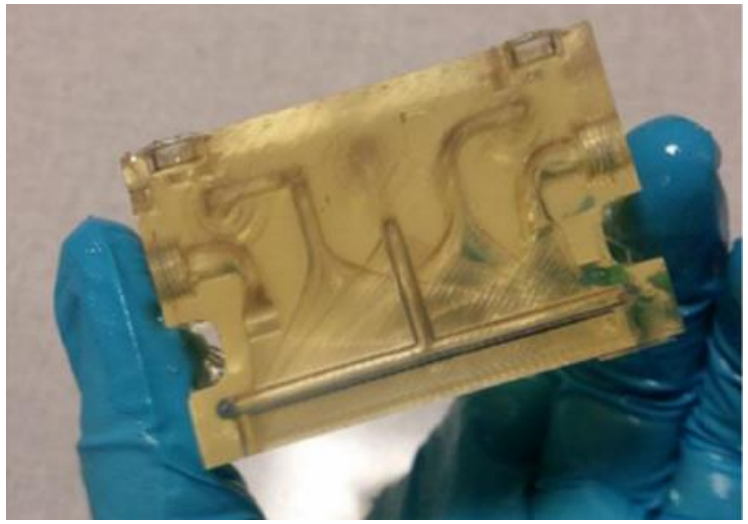


Applying 3D printing to our SALD!

Conventional manifold

3D printing gas manifolds!

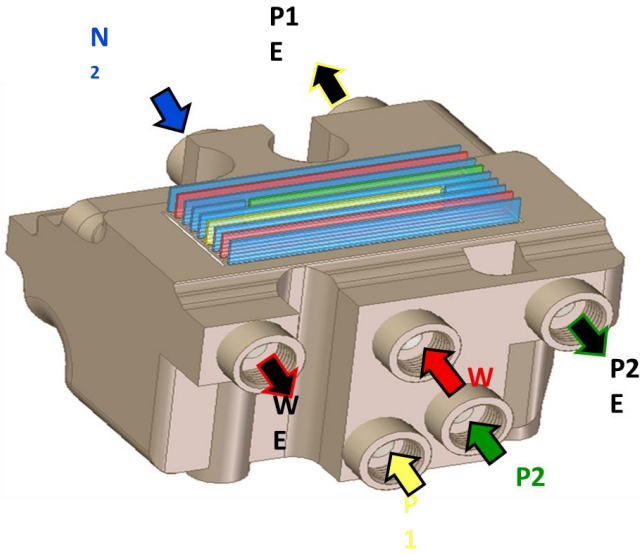


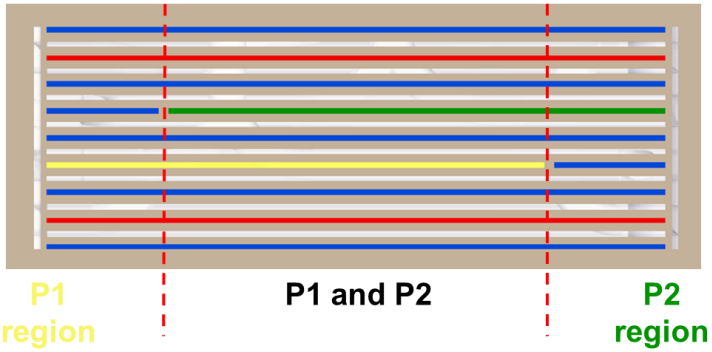


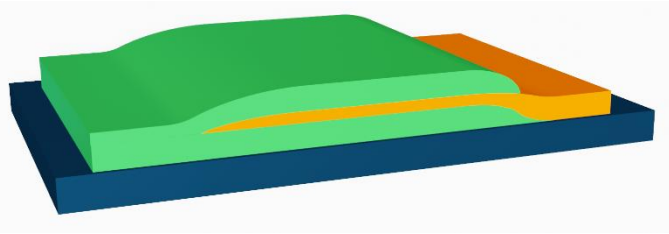
Masse de la Huerta, et al., Adv. Mater. Tech, 2021.

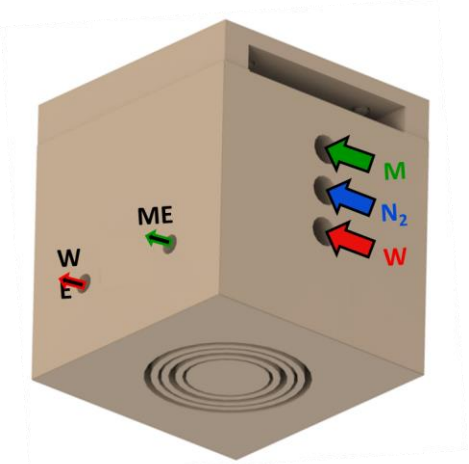
Selective deposition

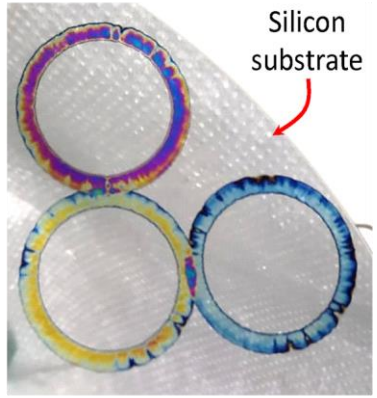
3D printing gas manifolds! Selective deposition

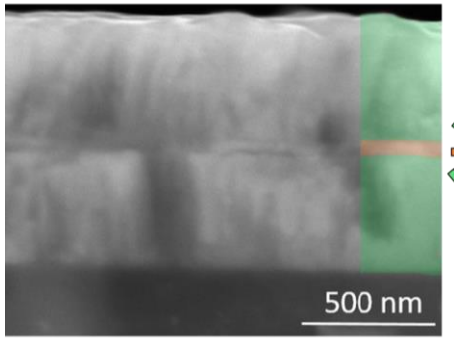


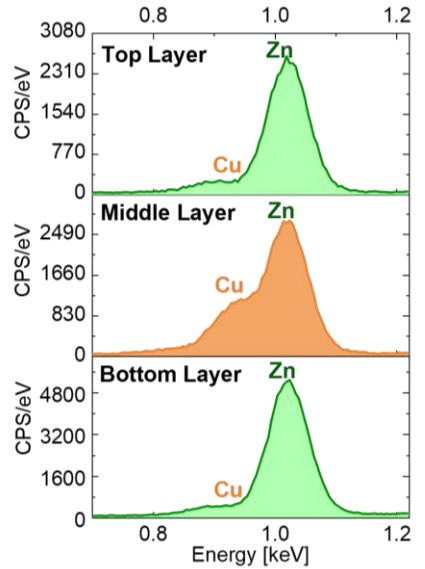








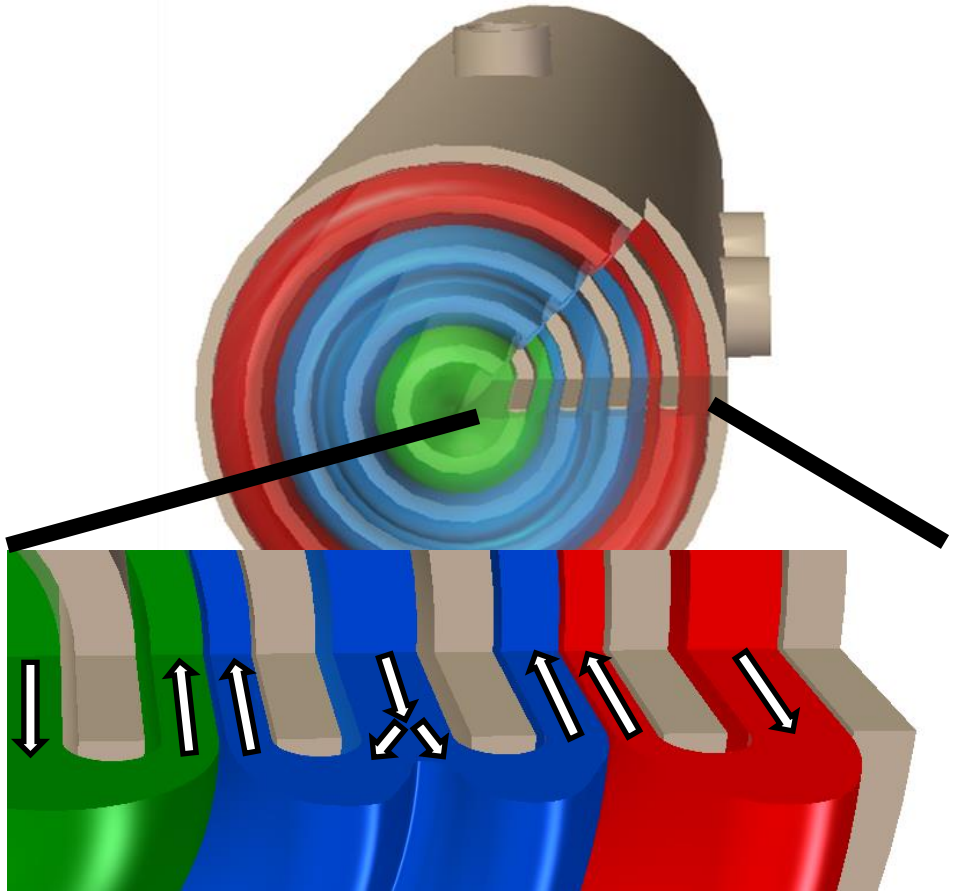




Masse de la Huerta, et al., Adv. Mater. Tech, 2021.

Scribbling functional materials

SALD PEN:* Concentric channels*. GAS-PHASE 3D printing of functional materials with nanometric resolution in Z



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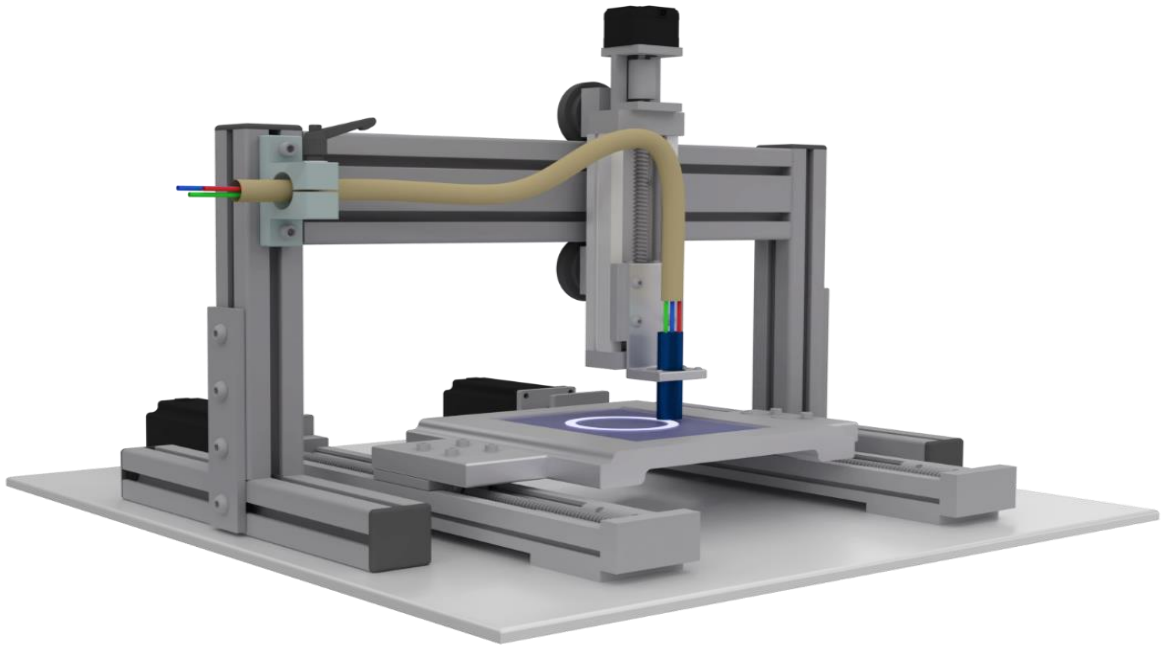
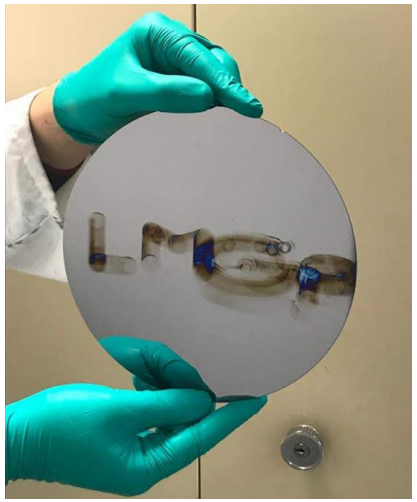
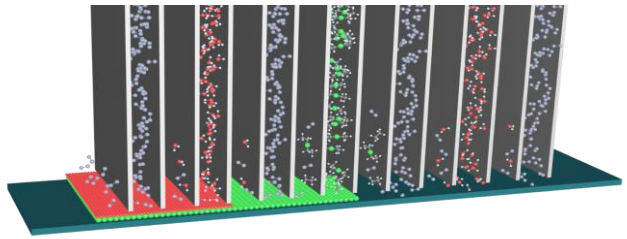




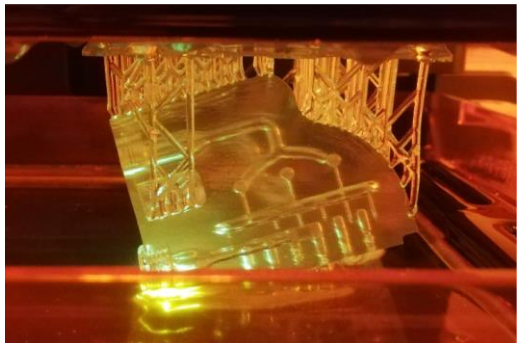
Masse de la Huerta, et al., Adv. Mater. Tech, 2021.

Conclusions

- *SALD: exciting approach for fast open-air deposition of functional materials*



- *3D printing allows the design and rapid and cheap fabrication, testing and optimizations of spatial close proximity heads*



- *Concentric channels allow free form deposition of materials with nanometric resolution in Z*

THANK YOU
FOR YOUR ATTENTION

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