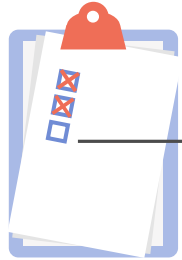


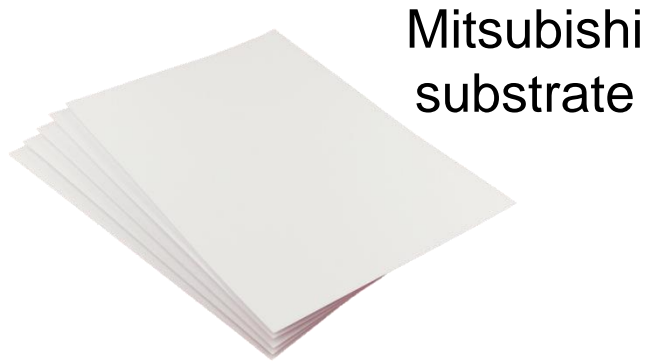
# DEMO: Inkjet-printing of nanobiosensors with consumer inkjet printers

**Massimo Urban**, PhD student

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Institute of Nanoscience and Nanotechnology (ICN2)



# Materials and equipments



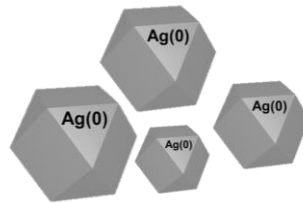
Mitsubishi  
substrate



Laminating  
Pouches

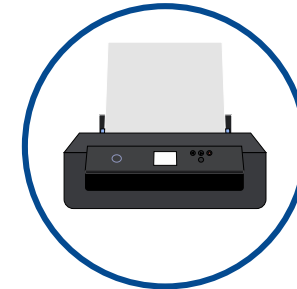


AuNPs  
inks



AgNPs  
inks

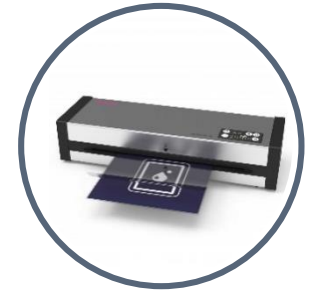
Wax printer



Consumer  
inkjet printer

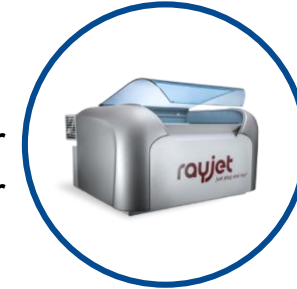


Office  
equipment

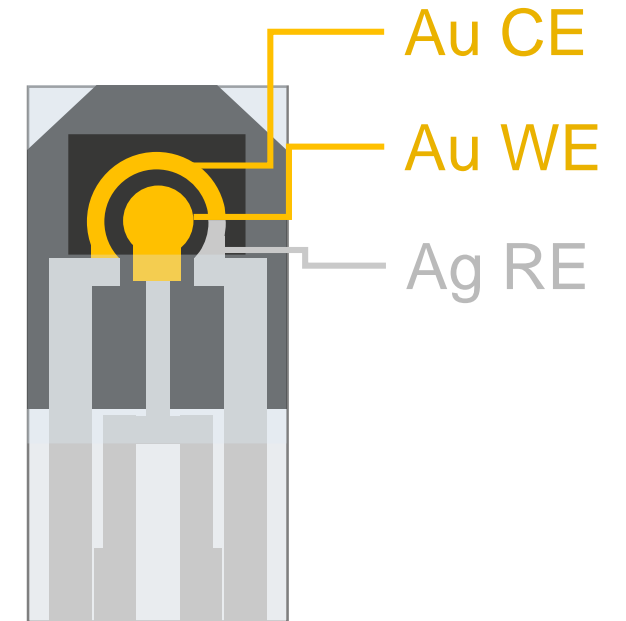
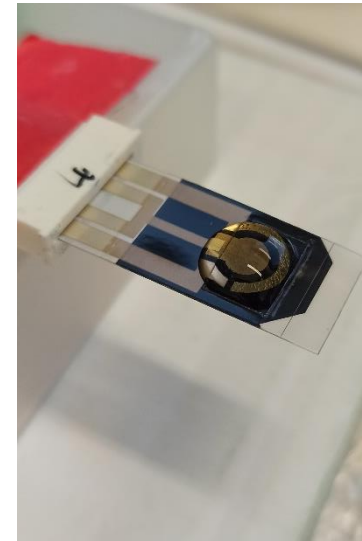
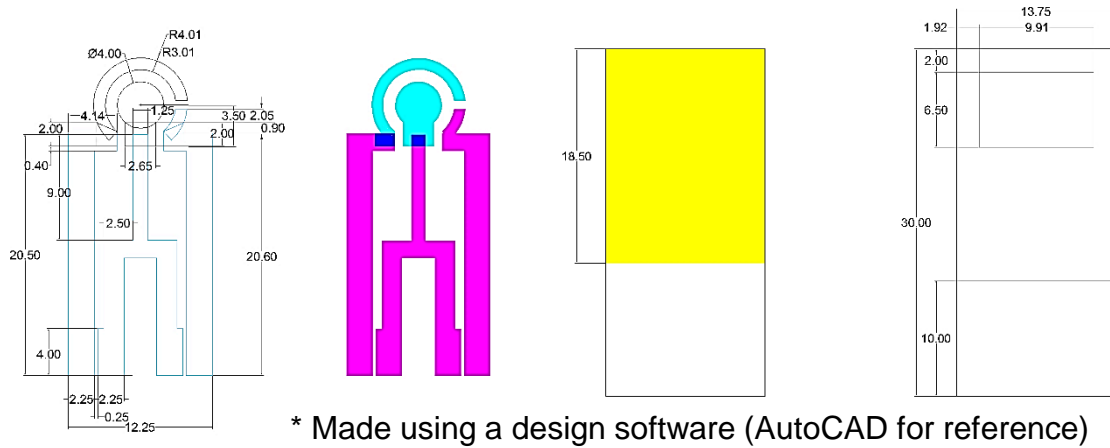


Laminator

Laser  
cutter/plotter



# Step 1: Design and preparation for the printing



Top view



- Assign to each printer color slot a specific material
- Prepare the PDF files for each individual tool

## Step 2: Inkjet printing of the functional materials

< 5 min 



① Loading of the paper



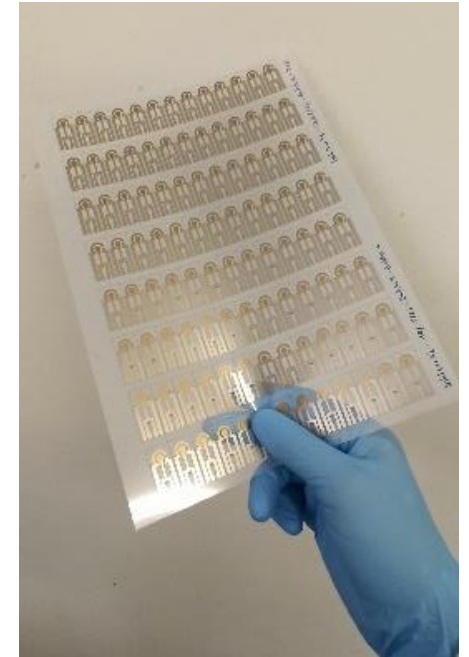
② "Plug and print"



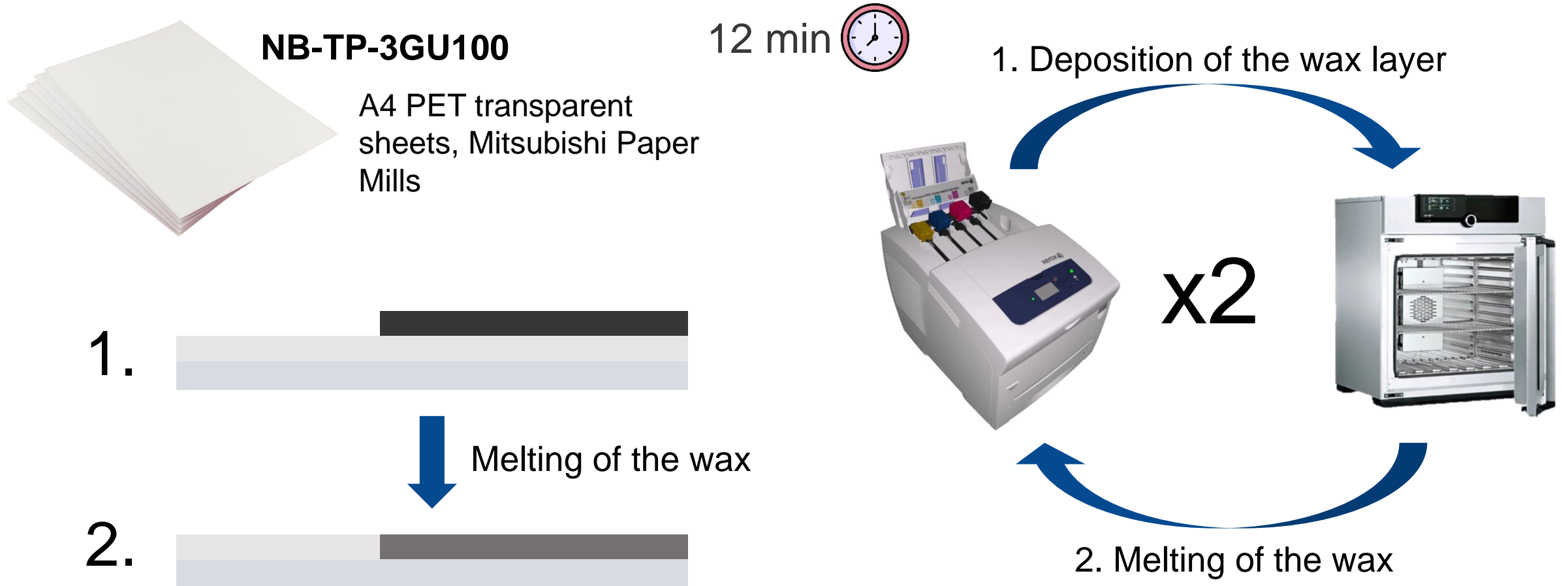
③ Simultaneous multimaterial printing



④ Printed foundation of the electrochemical platform



# Step 3: Wax printing/handling of the insulation/passivation layers

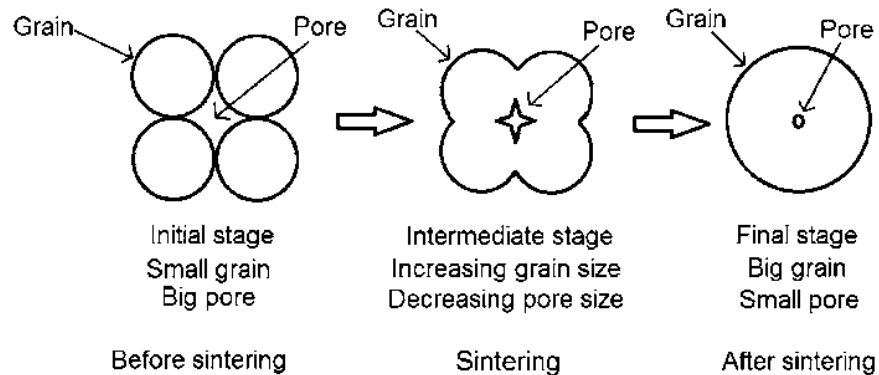


## Step 4: Removal of the excess wax over the electrode surface



## Step 5: Click Sintering of the AuNPs

43 min 



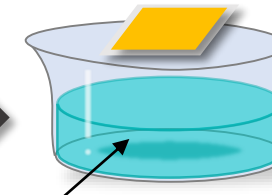
Temperature  
sensitive  
substrate



Patterned  
AuNPs films



“Click” sintering



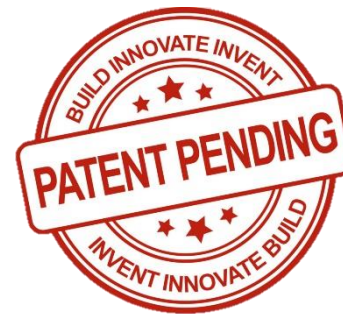
Sintering solution  
( $\text{NaBH}_4$ )

10 min

Sintered  
AuNPs films



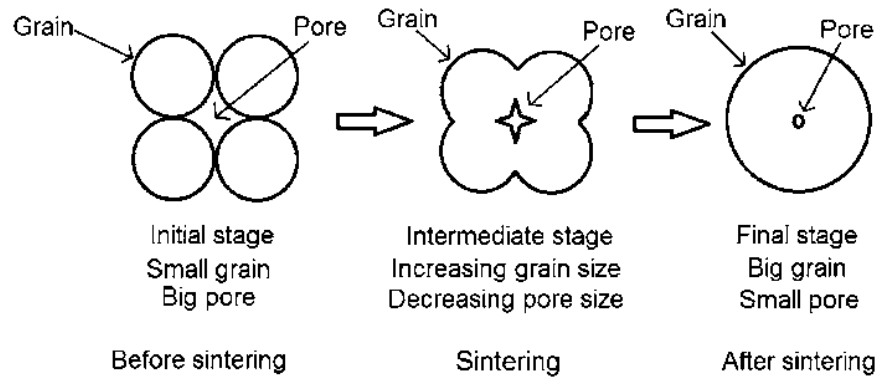
Urban et al. Small 2024, 20, 2306167



- High processing temperatures
- Relatively long times
- Expensive equipments

# Step 5: Click Sintering of the AuNPs

43 min 

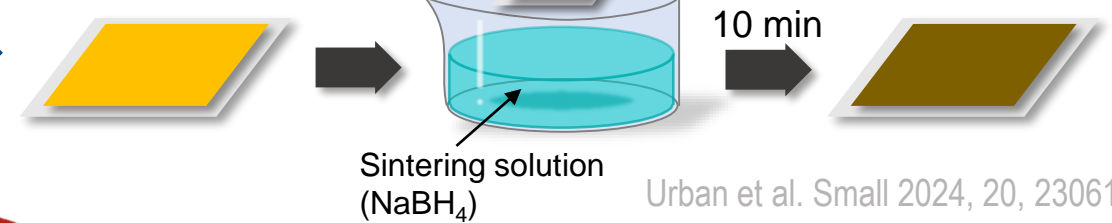


Temperature sensitive substrate

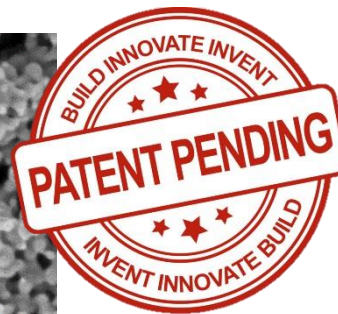
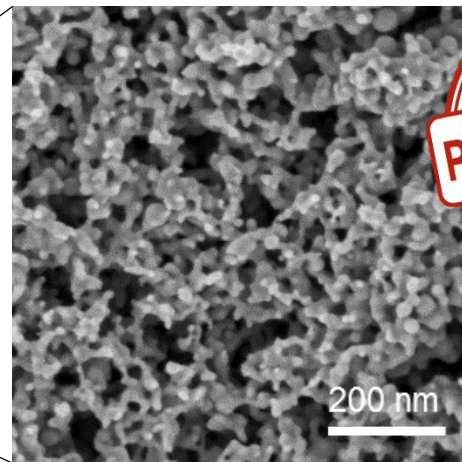
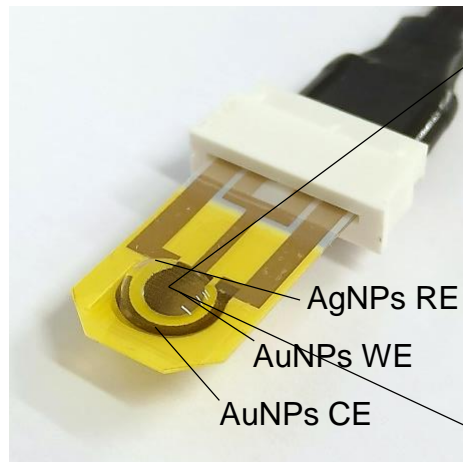
Patterned AuNPs films

“Click” sintering

Sintered AuNPs films



Urban et al. Small 2024, 20, 2306167





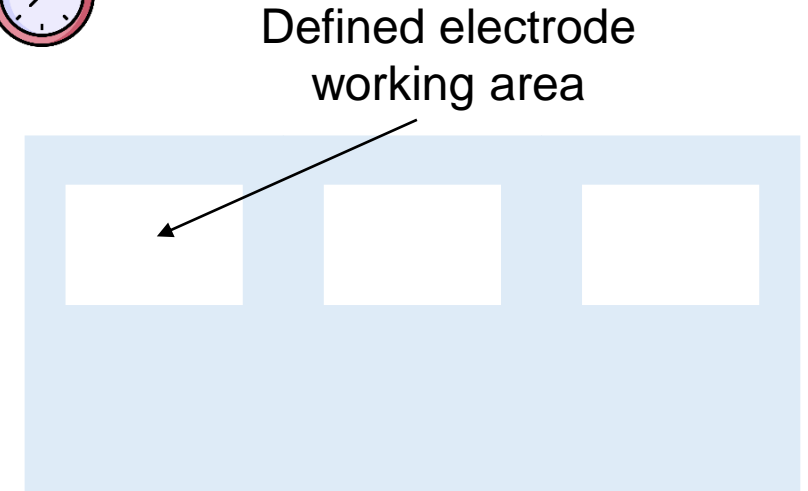
# Step 6: Lamination of the devices

10 min 



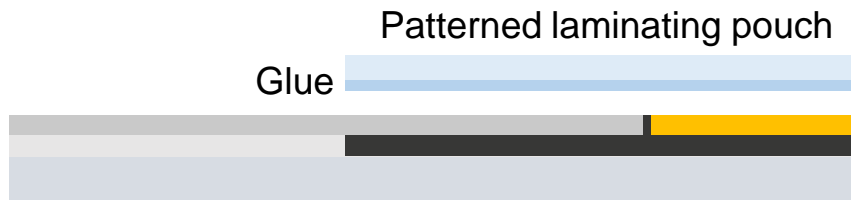
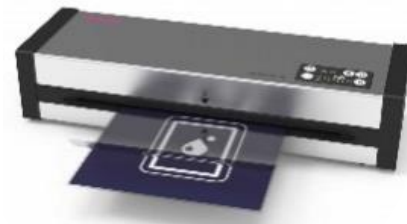
## Laminating Pouches

A4 transparent sheets,  
available in every  
stationary store



Defined electrode  
working area

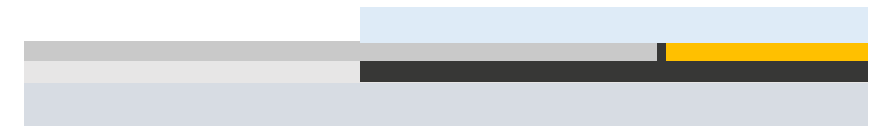
Patterned laminating pouch



Patterned laminating pouch

Glue

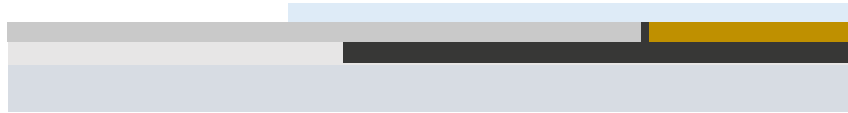
Sintered electrode



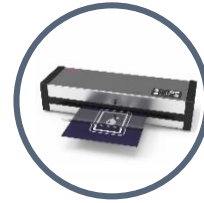
Finished sintered electrode

Rosati et al. Biosensors and Bioelectronics, 196, 2022, 113-737

Urban et al. Small 2024, 20, 2306167



Side view



4

Patterned  
insulating  
pouch

3

Wax filler

2

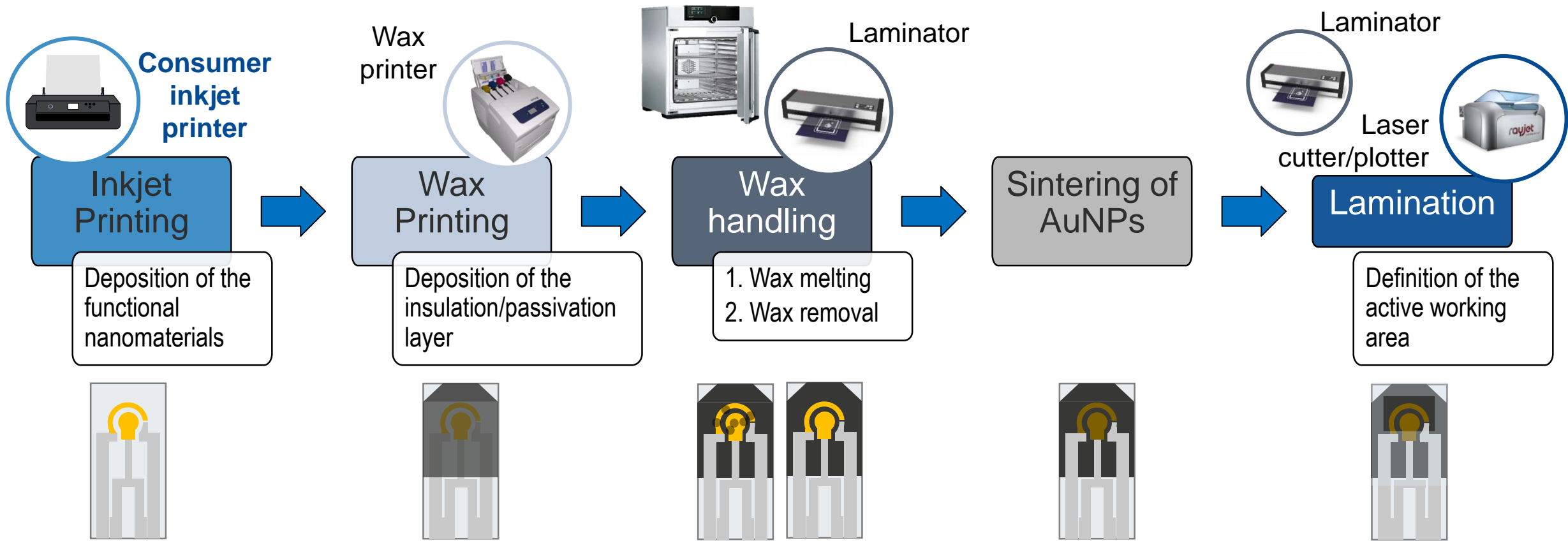
Metal  
nanoparticles  
as a transducer

1

Plastic porous  
substrate

# Summary of the tutorial

70 min  Total fabrication time from start to finish



# Conclusions

- **Inkjet printed electrodes** are a versatile option for the fabrication of nanobiosensors, that can be easily **mass produced** in a lab **without clean-room facilities** and consumer equipment
- It allows the **full customization** of the sensor **based on the specific application** with just some basic drawing software
- The combination of nanomaterials and post-treatments is valuable and shows the **importance of working not only on the device but also on the materials composing it**

# Thank you for the attention and don't forget to check out our group!



Thanks to:



... the Nanobioelectronics and Biosensors group!

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## Acknowledgements:



ICN2 is funded by CERCA programme, Generalitat de Catalunya. Grant SEV-2017-0706 funded by MCIN/AEI/ 10.13039/501100011033. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008701. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. The European Union can not be held responsible for them