





REGION BOURGOGNE FRANCHE COMTE



**µRoboteX** 

## New generation of nanofactories

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## **Motivations**

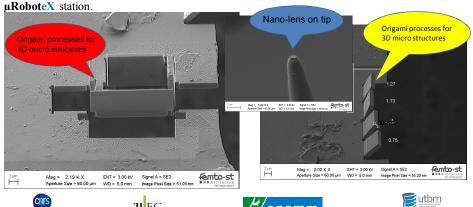
The aim of this study is to present the new generation nano factories under vacuum in order to produce new generations of 3D nano-structures by functionalizing, patterning, assembling with very high accuracy micro materials on top of metallic tips, or optical tips/fibers. This nano factory called **µRoboteX.** It consists of a Zeiss Auriga 60 dual beams SEM/FIB, in which we have added a GIS (Gas Injection System) and two micro robotic arms, Kleindiek and Smaract. By this way, with the 5DoF sample holder of the SEM, we have three 'hands' in the chamber, totaling 14 DoF, and we are able to pattern, etch, cut, fold, assemble and weld several materials, especially bio-sensors, CNTs, chemical and nano-photonic sensors, in real 3D structures.

• Auriga 60 from Zeiss with dual MEB/FIB beams, • Sample holder stage 5dof: X, Y,	Gas Injection System with: <b>XeF2</b> for etching and patterning materials and sensors, <b>W</b> (CO)6, Cyclopentadienyl <b>Pt</b> , for CVD thin layer or thin nano printing,	Auriga 60, Zeiss dual beam, SEM-FIB Chamber vacuum: < 1*10-6Pa Stage range: 200*200*80mm Planar rotation 360° + SmarAct 360° Tilt -15° to 54° Sample size: up to 10 ° wafer size Antivibrating system		
Z, Z' for <b>eucentric point</b> , $\Theta$ and SmarAct $\Theta$ ', -	Kleindick tip with 3DoF,	*	FEG Gemi Acceleration Probe curr	Electron Microscope (SEM) ini column ng voltage from 3kV to 30 kV rent from 2pA to 10nA 4*4mm <sup>2</sup> at 5.1mm
- <b>SmarAct</b> micro robot with 6DoF - X*Y*Z:150*70*70mm±10nm, Θy: Θz : 7°±0,001°, , Θx (tools) 360°±0,001°	Working space of <b>0,5mm3</b> for assembly the microstructures, CNTs and the micro-sensors		SEM magr	4 4 4 minutes 1, minut
Deposition and micror	Inlens, EBSD and SE2	Ges Injection Systems (GIS): e-bran; hbean ithloggaph deposition precursors: P(V, SO) etching precursors: P(V, SO) etching precursors: P(V, VSO)		
Silicon or silica patterning was realiz current, from 200pA to 2nA, in order assembly with or without XeF2. Thin patch of naphtalene or platinum la current density from 5 to 15 nA/µm <sup>2</sup> .	ted with high level of FIB to mill the structure before ayers were deposited with a	Bruker	nanomaripulator (24) ren Dispersive X-rey spectroscop reu detection:trom B (5) to Am (95) presidente: 12 eV	
just near the GIS nozzle, in the directi chamber never increases above 1*1 processes.	on of the gas flux. Vacuum	Mag= 2.05 KT BIT= 3.00W BysHA-Filem Aperins Size = 0.05 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 Km Rep. Pol Kar + 81 / W S 1 / W		
2 tips for nano manipulations	X Eff1 = 20/W Signal A = 552 mage Paties = 51 mm Signal A = 552 mage Paties = 31 mm		licro house of 20*10*15µm, with hemery for gas functions	Полиции <
Open Mag = 106 KX Drf + 300 W Spire A + 552 Fembo - 51   Appendix Size + 60.00 µm W0 + 51 mm Spire A + 552 Fembo - 51	20µm → Mag = 211 X Apenture Size = 60.00µm WD = 5.1m		1ag = 500 X ΕΗΤ = 3.00 kV perture Size = 60.00 μm WD = 7.4 mm	Signal A = SE2 Image Pixel Size = 223.3 nm

## Microstructures assemblied by Origami,

UFC

Thin silicon/silica patterned boxes microstructures were assemblied with the SEM's stage and µrobot on top of cleaved optical fibers. The set attachment was made with naphtalene and gallium beam by the way of IBAD layers during several processes. The surfaces of nano structures were prepared in clean room and pattern by lithography or FIB. Origami is used in order to realized 3D structures before installing the structures on top of cleaved optical fiber for optical interrogations, gas sensors or nano photonics sensors. The microscopic house on top of optical fiber was realize in order to summarize all the ability of the



<sup>A</sup>/ensmm

## Conclusion,

Important projects are on the way on **µRoboteX** station, especially in optical and nano-robotic fields, in order to assembly 3D structures on top of optical fiber or tips. This new technical facilities enlarge the scope of clean room processes and open the way for micro and nano assembly in the new generation of nanofactories. By this way, we can produce new generations of opto, bio, chemical, mechanical or gas NEMS or NOEMS.

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Labex X ction

