New generation of nanofactories

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Motivations

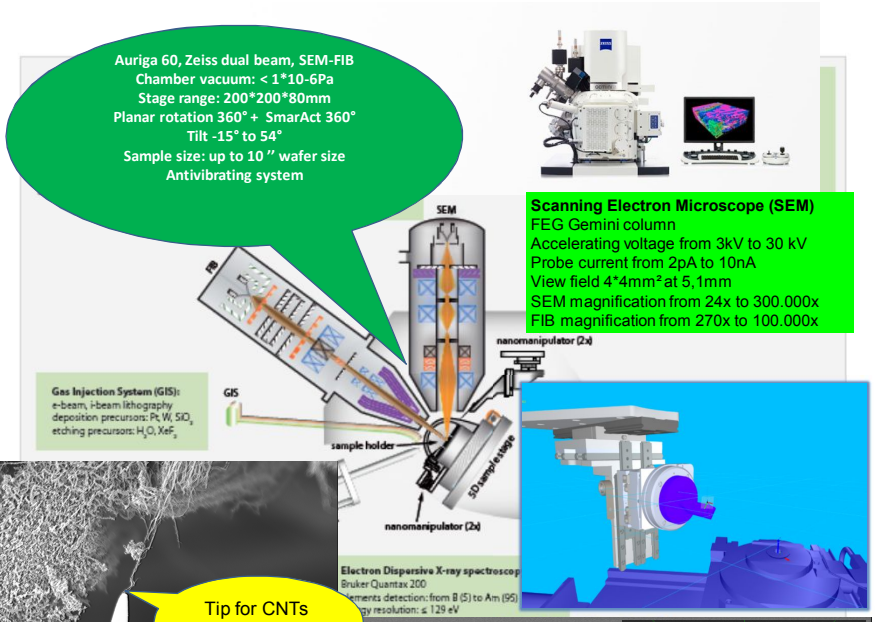
The aim of this study is to present the **new generation nano factories** under vacuum in order to produce **new generations of 3D nano-structures** by functionalizing, patterning, assembling with **very high accuracy** micro **materials on top of metallic tips, or optical tips/fibers**. This nano factory 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.

Operating conditions

- Auriga 60 from Zeiss with dual MEB/FIB beams,
-Sample holder stage 5dof: X, Y, Z, Z' for **eucentric point,** Θ and SmarAct Θ' ,

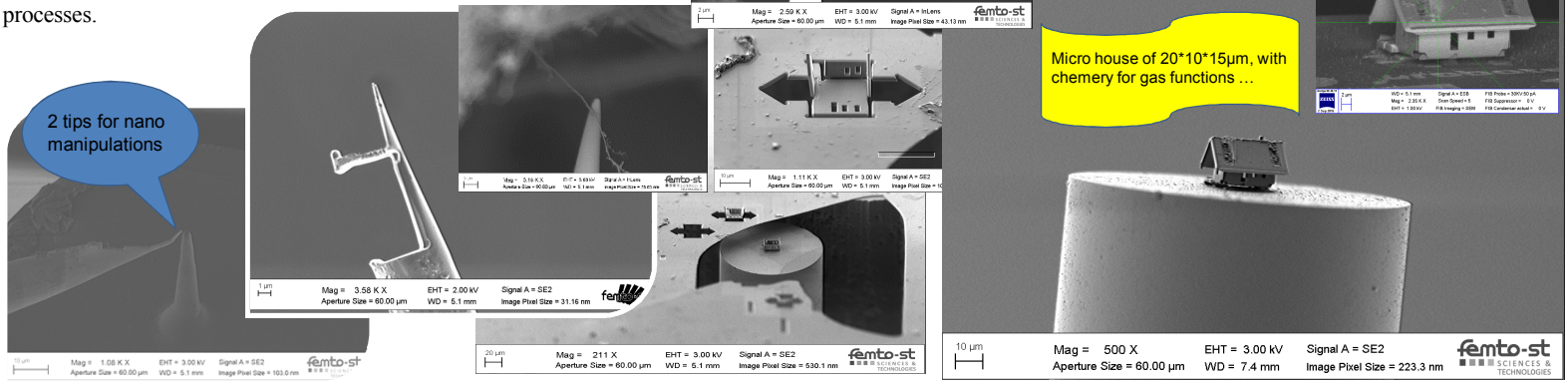
- **SmarAct** micro robot with 6DoF X*Y*Z:150*70*70mm**±10nm**, Θy: Θz : 7°±0,001°, , Θx (tools) 360°±0,001°

- Gas Injection System with: **XeF2** for etching and patterning materials and sensors, **W**(CO)6, Cyclopentadienyl **Pt**, for CVD thin layer or thin nano printing,
- Kleindick tip with 3DoF,
- Working space of **0,5mm3** for assembly the microstructures, CNTs and the micro-sensors…
- Inlens, EBSD and SE2



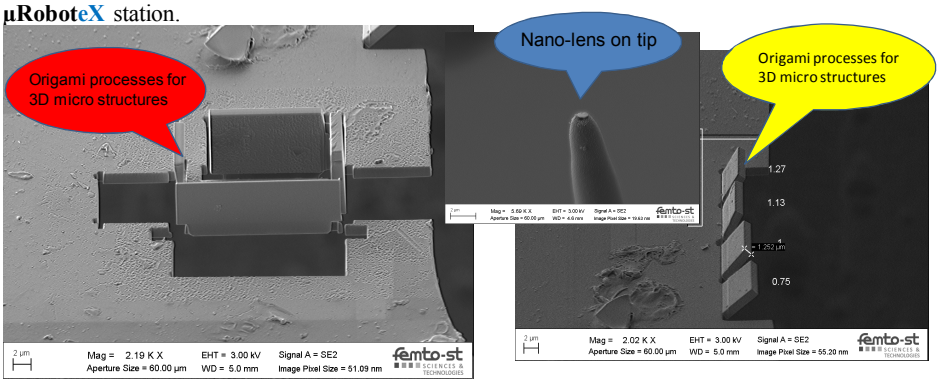
Deposition and micropatterning,

Silicon or silica patterning was realized with high level of FIB current, from 200pA to 2nA, in order to mill the structure before assembly with or without XeF2.
Thin patch of naphtalene or platinum layers were deposited with a current density from 5 to 15 nA/µm². Surfaces of 2*5µm² must be just near the GIS nozzle, in the direction of the gas flux. Vacuum chamber never increases above 1*10^{-5}mbar during deposition processes.



Microstructures assemblied by Origami,

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 **µRoboteX** station.



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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