Poster

FABRICATION OF NANO OBJECTS USING FOCUSED ION BEAM INDUCED DEPOSITION.

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1 – Introduction

We will show that using the local decomposition of molecules induced by focused ion beam (FIBIB), it is possible to constructed nanostructures on surfaces. The demonstration of these possibilities has been done using the decomposition of phenanthrene molecules ($C_{14}H_{10}$) in a dual beam machine for which we have developed our own electronic beam command. Various shape objects can be obtained like auto support carbon films, dot nets, sharp tips, nanoinjector, tubes….

2 –Experimental setup:

Focused Ion Beam Induced Deposition (FIBID) is a techniques that allow the local decomposition of a precursor absorbed on the surface. The nanofabrication station is a commercial scanning electron microscope coupled with a Ga^+ ion column. The SEM provide electrons from a tungsten filament (V=3kv to 30kV Ip = 1 to 10nA). The ion column provides Ga+ ions at 30 Kv with a resolution of 10nm. To get a deposit, one need first the injection of gas (precursor) in the area of the beam focus point keeping the pressure in the workstation chamber compatible with the electron and ion guns. This is obtained by using a temperature control reservoir coupled to a line ended by capillary. The position of the capillary is computer control by a 3 axis microstage. The precursor we used for the construction is the phenanthrene ($C_{14}H_{10}$). The phenanthrene is a powder at room temperature with a vapor pressure at 1.13 hPa at 118°C. It has been used by different authors for the building of nanoobjects (Matsui, Raith..). To construct objects of different shapes one needs a way of driving the beam on the surface. It is known that in FIBID the ion beam needs to be scanned at relative high frequency to prevent the milling by the high energy impinging ions and to allow the replacement of the absorbed molecules of precursor on the surface. To get a versatile beam command that allows the driving of the beam, we have designed our own computer command. This application relies on a commercial hardware data acquisition board with 2 analog outputs at 1.25 Mech./s , 8 digital Inputs/outputs and 8 analog inputs at 1,25Mech./s. This board is driven by a software written in graphical language so that it can be easily adapted to future needs. It has been designed to allow the modification of the beam command in real time. Since it is possible to observe with the SEM the construction of the object during FIBID, we can modify the parameters during the deposition process to get the shape we want.

3 **Results:**

To illustrate the possibility of this technique we give few examples on the figures bellow. The first example is a FIBID carbon film deposited over a hole going through the support on which we have deposited thin FIBID W wires Fig N°2 (a). The image obtained by TEM demonstrated that both deposits are transparent toward high energy electrons. It could be a nice way to get heated supports for TEM. Figure N°2 gives the SEM image of a dot network obtained by FIBID in 10mn. The dots are 150nm wide separated by 75nm. It possible with this to created on few square micrometers a structuration of the surface by object around hundred nanometers. Figure N°4 give the possibility offered by this technique to design a mask on auto supported carbon membrane by FIB milling. We are able to make grooves of 50nm width separated by 80nm.

3 – Conclusion

These results open a wide range of applications like nanostructuration of surfaces, new support for TEM, tip for proximal probe, mold for microfluidic or nano imprint. We think that diamond like carbon has many interesting properties (tribologic properties, biocompatibility, mechanical properties, hardness…). Nanoobjects made of carbon like diamond can be used in very different applications in nanoscience.

References:

[1] Claudia Menozzi, Gian Carlo Gazzadi, Andrea Alessandrini and Paolo Facci *Ultramicroscopy, 104, Issues 3-4, October 2005, 220*

[2] A. Perentes, A.Bachmann, M. Leutenegger, I. Utke, C. Sandu and P. Hoffmann *Microelectronic Engineering, 73-74, June 2004, 412*

[3] J. Fujita, M. Ishida, T. Ichihashi, Y. Ochiai, T. Kaito and S. Matsui *Nuclear Instr. and Meth. in Phys. Res. B: Beam Interactions with Materials and Atoms, Volume 206, May 2003, Pages 472-477*

Figures:

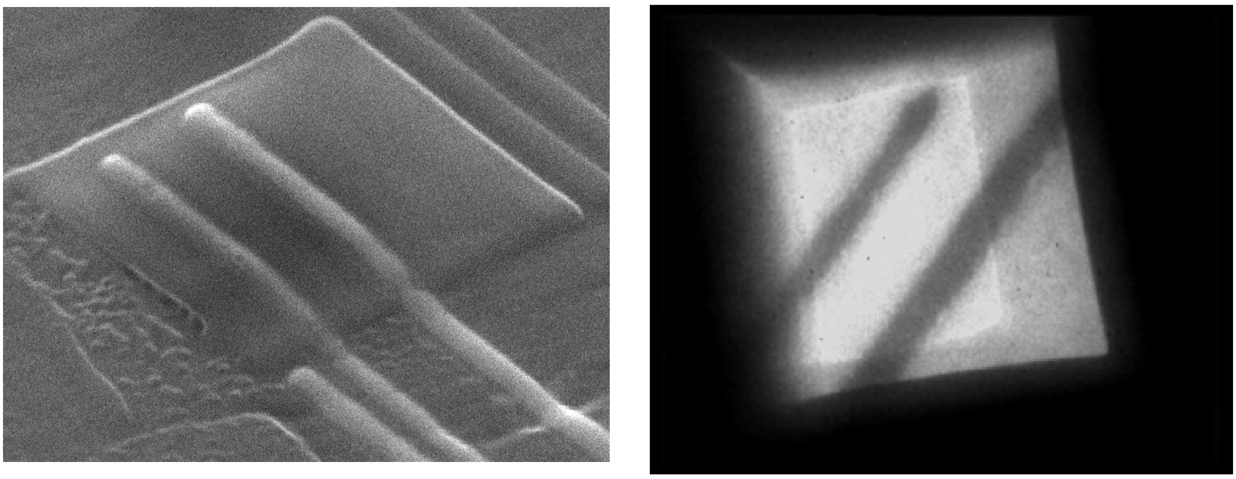

Fig N°1 :(a) SEM image and (b) TEM image of FIBID deposits

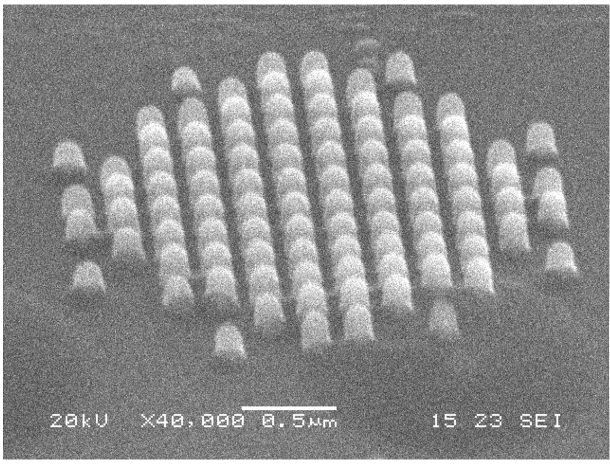

Fig N°3 Network of dots

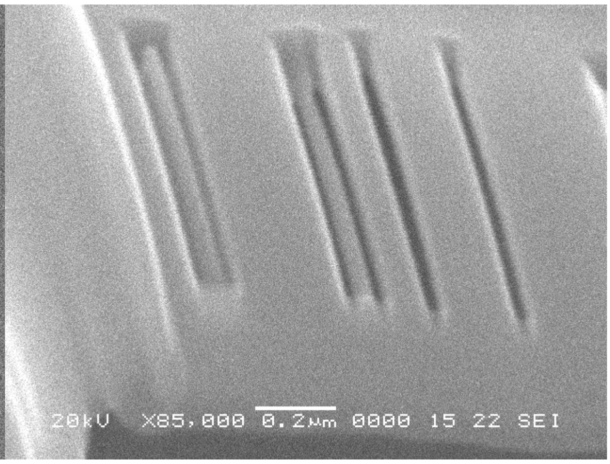

Fig N°4 Mask designed by FIB milling of a carbon membrane