IMM Institute for Microelectronics and Microsystems
Consiglio Nazionale delle Ricerche

AGRATE UNIT

NOTICE OF PRELIMINARY MARKET CONSULTATION

Subject: Market consultation preparatory to the call for a negotiated procedure without prior publication of tender for the acquisition of a "System for the physical deposition by molecular beam (MBE) of ultra-thin films" to be installed in the laboratory of the Agrate Brianza Unit of the Institute for Microelectronics and Microsystems of the National Research Council (CNR-IMM).

CIG 7748832A72 - CUP B91I16000030006

Hereby the Contractor "Institute for Microelectronics and Microsystems of the National Research Council," (in the following CNR-IMM), in the framework of the XFab project (Xene Fabrication for a Two-Dimensional Nanotechnology Platform), intends to initiate a negotiated procedure without prior publication of a tender for the acquisition of a system for the physical deposition by molecular beam (MBE) of ultra-thin films (hereinafter called "MBE apparatus") in the laboratory of the Agrate Brianza Unit of the CNR-IMM.

This notice pursues the purposes of art. 66, paragraph 1, of Legislative Decree no. 50/2016, as amended and face - on the basis of the determination n ° 950 of September 13, 2017 National Anti-Corruption Authority (ANAC) "Guidelines n ° 8 -Use of negotiated procedure without prior publication of a contract notice in the case of supplies and services deemed non-perishable " (Gazzetta Ufficiale - Serie Generale n. 248 of October 23, 2017)- to confirm the existence of the conditions that allow, in accordance with art. 63 of Legislative Decree no. 50/2016 and subsequent amendments, the use of the negotiated procedure in question, or to identify the existence of alternative solutions for the acquisition of the above-mentioned MBE apparatus, with the characteristics, requirements and capabilities identified by the CNR-IMM and detailed in the technical specifications attached to this notice.

Economic operators in the market who believe they can provide an MBE apparatus responsive to the needs and requirements of the CNR-IMM, or to suggest and demonstrate the viability of alternative solutions, must submit their technical proposal, in relation to the technical annex attached, no later than January 25, 2019 at 1:00 p.m. (CET) to the PEC e-mail protocollo.imm@pec.cnr.it; and, for foreign companies, to e-mail address amministrazione@imdm.imm.cnr.it, reporting the subject as follows: *«Application to market consultation preparatory to the call for a negotiated procedure without prior publication of tender for the acquisition of a "System for the physical deposition by molecular beam (MBE) of ultra-thin films" to be installed in the laboratory of the Agrate Brianza Unit of the CNR-IMM».*
Participation in this consultation does not result in expectations nor whatsoever right, and it does not imply any invitation to propose an offer, nor in any way it commits the CNR-IMM in relation to the involved operators, provided that the acquisition in point is subjected to the appropriate procedure to be carried out by the CNR-IMM under the already mentioned Legislative Decree no. 50/2016 and smi.
Requests for any further information from the parties concerned in accordance with the principles of transparency and fair-play, may be sent to the person responsible with the Procedure, Mrs. Maria Giovanna Santoro at the following address:

- E-mail: mariagiovanna.santoro@cnr.it

Agrate Brianza, January 8, 2019

Firmato da
Tallarida
Graziella

The Head of the Procedure Act
Mrs. Maria Giovanna Santoro

Maria Giovanna Santoro

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Data sheet - Requirements for "System for physical deposition by molecular beam (MBE) of ultra-thin films".

Supply

The MBE apparatus aims to enhance and expand the deposition of ultra-thin layers of different materials with the intent to grow two-dimensional layers and encapsulate them in stable configurations by integrating the deposition infrastructure already present in the laboratory of the Agrate Brianza Unit of the CNR-IMM. Specifically, the MBE apparatus should allow for the deposition under ultra-high vacuum of: (i) two-dimensional layers (thickness of nanometer or sub-nanometer) of different elements including silicon, tin, germanium, phosphorus; (ii) of metals and / or oxides (thickness from ten to one hundred nanometers) to be used as substrates for the layers described in (i); of protective layers of a few nanometers thick oxide. In addition to the deposition of materials, the MBE apparatus will be devoted to the preparation of substrate surfaces and analystical characterization according to the following specifics.

Requirements

The MBE apparatus must be necessarily compliant with three categories of requirements (technical, compatibility and spatial dimensions), all included nothing excluded, as described below.

1. *Technical requirements.*

The MBE apparatus must incorporate:

a) a chamber for the molecular beam epitaxial (MBE) deposition (called hereinafter "deposition chamber") in ultra-high vacuum environment in the pressure regime of 10^{-10} mbar equipped with:

i) cylindrical chamber with diameter of 25,4 cm (twentyfive-comma-four centimeter) made of non-magnetic steel, equipped with optimized ports for additional options and viewports (with viewport shutters) for an optimal visibility during sample transfer, and designed to host seven effusion cells or evaporators (hereinafter reported as "cells");

ii) up to three effusion cells and / or evaporators with related electronic control panels intended for the deposition of aluminum, noble metals (silver or gold), tin, pnictogens or calchogens like phosphorus or antimony or tellurium), and/or dielectrics ;

iii) calibration device of the deposited thickness ("thickness monitor") with its electronic control and reading panel;

iv) a five-axis manipulator with heating/cooling stage enabling to support and move samples having area in the range between 4 and 100 mm^2 (four and one-hundred millimeters-squared) inside the deposition chamber and to the analysis chamber (see item c) in the following), equipped with a cryogenic cooling system (liquid nitrogen) for operating temperatute down to -150°C (minus onehundredfifty degree Celsius) and an heating system for operating temperatures up to 900 ° C (ninehundreds degrees Celsius) by means of a ceramic heater or similar solutions (both systems cooling and heating must be designed for use during deposition) with remote control of the heater power supply, and thermocouple type K on the sample stage included, sample stage mounted horizontally with 25 mm z-travel (in/out), ±12.5 mm x/y travel, ±180° polar rotation around the z-axis and continuous azimuthal rotation around the sample normal (all rotations actuated manually), electrically isolated from ground potential so that a bias voltage can be applied to the sample;

v) customized layout of the deposition chamber for the access of the manipulator as described in item a.iv) into the analysis chamber (see item 1.c) in the following).

vi) ion gauge for base pressure monitoring and quadrupole mass analyzer with the related electronic control panels;

vii) ion gun operating through flow of argon to be integrated at this stage or in the step described in point b) and with its electronic control panel, however having direct ion flux towards the surface of the sample on which to operate the depositions;

viii) pumping system with related electronic control panels, based on low vacuum stage by means of "scroll" pump, the high vacuum stage by means of the turbomolecular pump, and a stage of ultra-high vacuum by means of an ion pump for a guaranteed pressure of $5x10^{-10}$ mbar (five times ten to the minus ten millibar) at least;

- ix) inlet valve for dosed process gas (eg. oxygen, nitrogen, etc.) known as "leak valve";
- x) inlet of venting gas (nitrogen);
- xi) efficient liquid nitrogen cryopanel;
- xii) security system for the interlock in the hardware;
- xiii) evaporation control software, including interfaces to PID control loops and read-out relevant system status parameters, and software-controlled hot air bakeout of the system; in particular the control software should include: -Labview based program that allows for running and storing individual processes or recipes, - all the necessary interface hardware as well as a cooling water distribution manifold for the deposition sources with cooling water flow monitoring and suitable safety interlocks, - Interfaces with PID heater controller/power supply of the cells as described in item 1.a.ii);
- xiv) bakeout covers adapted to the whole MBE apparatus.

b) Loading chamber of samples to be interfaced with the deposition chamber (hereinafter referred to as "loading chamber") through the use of valves and connections to the pumping system and / or differential pumping enabling the insertion of samples from atmospheric pressure environment, and their transfer to the ultra-high vacuum environment without venting the deposition chamber. The loading chamber must include:
- i) a fast entry load stage for loading/unloading of up to five samples inserted in appropriate sample holders, equipped with Viton-sealed quick-access door for fast and easy sample exchange;
- ii) an introduction stage to be used as a buffer/preparation chamber with a base pressure of than $5x10^{-9}$ mbar (five times ten to the minus nine millibar), equipped with a 67 l/s (sixtyseven liters per second) turbomolecular pump and pressure monitoring;
- iii) a transfer system to the deposition chamber capable of transferring samples from the fast entry load stage to the introduction stage and to the deposition chamber;
- iv) ion gun operating through flow of argon to be integrated at this stage or in the stage described in point a) and with its electronic control panel if not provided in the deposition chamber;
- v) compatibility with transportable ultra-high vacuum suitcase by means of a removable/fitting flange.

c) Analysis chamber interfaced with the deposition chamber through a special flange (hereinafter called "analysis chamber"), operating under conditions of ultra-high vacuum obtained by pumping the deposition chamber and / or by differential pumping, and containing an analysis system based on low energy electron diffraction (LEED) and Auger spectroscopy (with its electronic control panel) working with electron beam irradiation from a lanthanum hexaboride filament, controlled via remote software (compatible with PC equipped with Windows 10 as a operative system), and enabling the processing of the acquired data; sample transfer takes place from the deposition chamber to the analysis chamber by means of the manipulator described in item 1.a.iv) in order to have LEED analysis of samples.

2. *Compatibility specifics.*

a) The deposition chamber as described in 1.ai) must be compatible with the insertion of an additional cell consisting of a silicon sublimator already available at the Agrate Brianza Unit and corresponding to the model in Fig. 1 originally provided by Omicron Nanotechnology GmbH (now Scienta Omicron GmbH), whose inner cylindrical space consists of a 16 cm (sixteen centimeters) footprint and whose outer cylindrical footprint consists of a 40 cm (forty centimeters) footprint including room for the cable connections and water recirculation lines; this cell is interfaced to the deposition chamber via DN40CF flange;

b) The deposition chamber as described in 1.ai) must be compatible in terms of both interfacing and sample transfer with an analysis system for Scanning Tunneling Microscopy as in the picture of Fig. 2, originally manufactured by Omicron Nanotechnology GmbH (now Scienta Omicron GmbH) consisting of a steel chamber to be interfaced to the deposition chamber via a DN160CF flange, a wooble-stick manipulator with an external maximum extension of 35.7 cm (thirty-five-point-seven centimeters) and an inner carousel holder;

c) The deposition chamber in 1.ai) must provide compatibility with the addition of an analysis chamber that is substitutional for or complementary with the one required in point 1.c) (the connection between the deposition chamber and the additional analysis chamber must be operated through a magnetic manipulator arm or a similar system, interfaced via a DN40CF flange) both in terms of interfacing flange and sample transfer.

3. *Spatial footprint specifications.*
The system inclusive of the deposition chamber, the loading chamber and the analysis chamber, must have a largest allowed size of 2.5 x 1.5 m^2 (two-comma-five by one-comma-five squared meters) excluding the footprint of the electronic panel rack with largest allowed size of 50x90 cm^2 (fifty by ninety squared centimeters) and of the PC desktop. This footprint is binding for the installation of the apparatus and defines a necessary requirement of selection regardless of the compliance of the points 1. and 2.

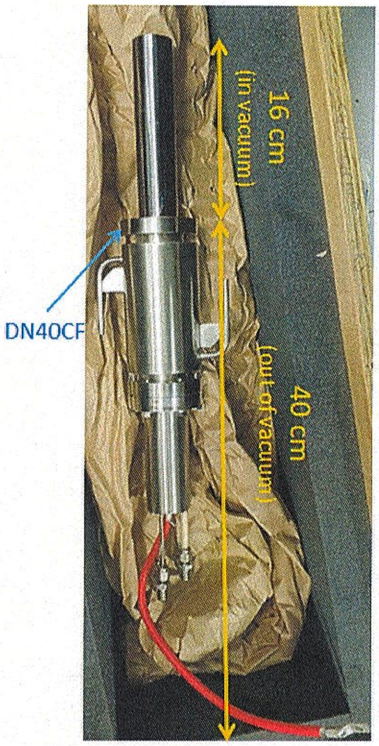

Fig. 1

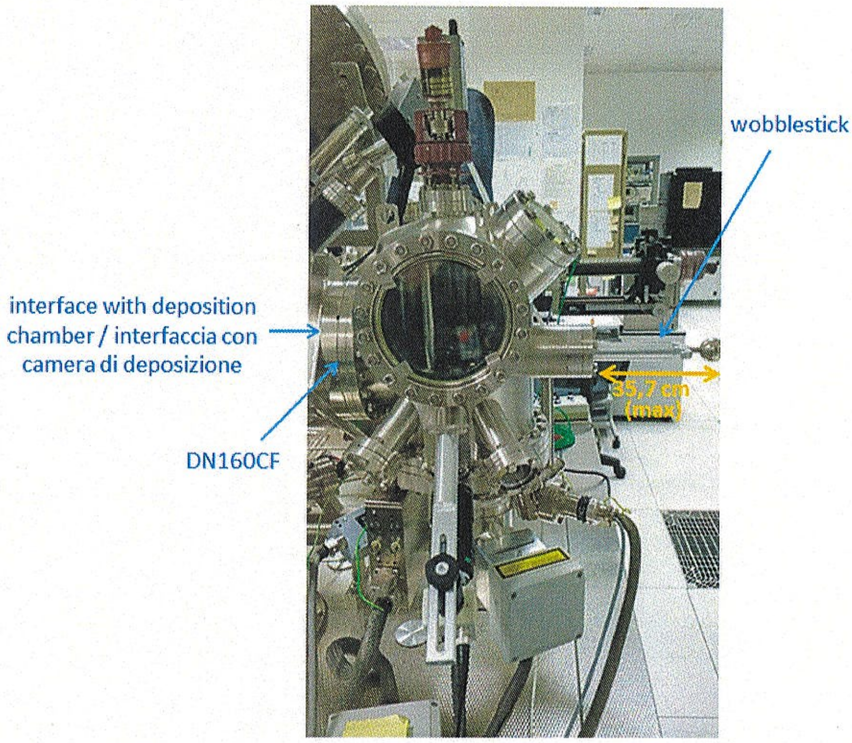

Fig. 2

Tools identified and expected costs
The Contractor identified as the only product able to meet the requirements mentioned in the previous point, the system called "Lab10" produced by Scienta Omicron GmbH as detailed at:

https://www.scientaomicron.com/en/products/lab10-mbe-system/instrument-concept

and distributed in Italy by LOT-QuantumDesign Ltd. at a price of € 350,000.00 (three-hundred fifty thousands/00 Euro), excluding VAT. The price include the overall cost of the system as detailed above, and the cost of shipment, installation, and training of the MBE apparatus with a delivery time no later than six months from the emission of the purchase order. The hook-up costs are in charge of the CNR-IMM.

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