

SPECIFICATION SHEET

Supply, installation and starting-up of a Wet process system for Through Glass Via (TGV) etching and electroless copper metallization for the Pilot Line PIXEurope at ICFO

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CLAUSE 1. Object of the contract

The purpose of this contract is the supply, installation and commissioning of a **Wet process system for Through Glass Via (TGV) etching and electroless copper metallization** for the Pilot Line PIXEurope at ICFO for ICFO's laboratory.

The types of items supplied are linked to the CPV (Common Public Procurement Vocabulary), **38000000-5** Laboratory, optical and precision equipment (except glasses).

CLAUSE 2. Needs to satisfy

PIXEurope is a European pilot line initiative aimed at establishing a fully integrated, open-access manufacturing chain for the development and industrialization of advanced photonic integrated circuits (PICs).

Within this context, the development of glass-based interposer technology for advanced co-packaged optics is of crucial importance, affecting directly the outcomes of the project and the impact of the whole initiative. Glass-based interposers are in fact emerging as key components for applications like high-performance computing, telecommunications, sensing, and quantum technologies. In particular, glass-based interposers enable high-density electrical and optical interconnections, respectively through Through Glass Vias (TGVs) and advanced fiber-based I/O interfaces.

To develop efficient and scalable TGVs, for electrical interconnection, and optical fiber-based interfaces, precise and high-throughput glass micro-structuring is required. LIDE processing is the ideal approach to this kind of manufacturing, enabling high-aspect-ratio and high-precision structuring of glass by combining laser modification with selective wet etching, allowing the fabrication of dense and accurate TGVs and microfeatures. In particular, LIDE process, compared to standard laser induced selective etching, enables lower TGV roughness and reduced defects in glass structures, while keeping high throughput and micrometric accuracy; because of this, LIDE is particularly suitable for reliable electrical interconnections and high-performance optical integration in high volume manufacturing of glass interposers.

In the development of the project, ICFO is in charge of the fabrication of the glass-based interposer, including the micro-structuring of the substrate for electrical and optical interconnections. Therefore, ICFO needs to acquire a wet process system for Through Glass Via (TGV) etching and electroless copper metallization compatible with LIDE processing.

The system is required to support reproducible and high uniformity wet chemical processing of glass wafers with TGV structures, enabling:

- Alkaline glass etching (KOH and NaOH based)
- Rinsing, cleaning, activation, reduction and adhesion promotion
- Electroless copper seeding and metallization
- Controlled batch handling and drying
- Safe operation in cleanroom and pilot line environments

The system shall be suitable for process development, characterization, and stable pilot production, with high availability, traceability, and safety.

CLAUSE 3. Technical requirements

Technical proposal structure - minimum mandatory equipment characteristics

3.1 Technical proposal structure

The system must include all the following functionalities.

3.2 Machine overview

The system shall be a semi-automatic modular wet bench including:

- Batch processing of glass wafers up to 200 mm (8"), thickness 100–800 μm
- Wafer holder carrier with maximum 5 slots
- Manual loading and unloading by the operator (dry in/dry out)
- Automatic execution of process recipes once a batch is loaded
- Integrated robotic carrier handling
- Integrated chemical supply and waste handling for the etching modules
- Manual chemical supply and waste handling for the e-less modules
- Fan Filter Units above all modules ensuring ISO 3 cleanliness inside the tool

All process modules shall be capable of fully automatic operation, with manual and stop modes for maintenance and troubleshooting.

3.3 TGV etching modules

The system must include at least:

- Hot KOH etching module (make-up mixture of KOH and DI water)
- Hot NaOH etching module (make-up mixture of NaOH and DI water)
- Quick Dump Rinse (QDR) modules, hot and cold DI water

Each etch module shall provide:

- Operation up to 130 °C with equal or better than $\pm 2^\circ\text{C}$ stability in stand-by
- Chemically resistant welded tanks with electrically operated lid (ECTFE or equivalent)
- Uniform circulation via diffuser plates and spray bars
- Redundant temperature control and safety monitoring
- Concentration monitoring of process bath (triggering automatic replenishment of DI water and NaOH/KOH)
- Programmable 2D agitation
- Re-filling of the chemicals via management chemicals cabinets
- Re-filling of DI water via facility
- Automated make up, replenishment, and cleaning sequences

3.4 Electroless copper metallization modules

The system shall include a complete electroless Cu process chain, comprising:

- Electroless Cu deposition module
- Reducer module
- Two activator modules

- Cleaning modules
- Rinsing (QDR) modules
- Adhesion promoter module with N₂ drying

Requirements include:

- Tight temperature control with equal or better than +/- 1°C stability in stand-by
- Diffusor plates at the bottom of process tank for uniform flow
- Programmable multistep recipes
- Manual re-filling of the chemicals
- Refilling of DI water via facility
- Controlled draining and waste segregation

3.5 Drying modules

- Integrated Marangoni N₂ / IPA dryer
- Diffuser plate at the bottom of process tank for uniform flow
- Level sensor system
- Uniform wafer and carrier drying
- Manual re-filling of the chemicals

3.6 Robot handling

- Automatic carrier transport with X and Z axis
- Collision and carrier presence monitoring
- Adjustable speeds per module for up- and down- movement
- Automatic gripper cleaning after loading/unloading the carrier

3.7 Chemical supply and waste system

- Five chemical supply/waste cabinets for:
 - NaOH supply and waste
 - KOH supply and waste
 - IPA supply
- Canister volumes up to 25 liters for NaOH and KOH
- Canister volumes up to 10 liters for IPA
- Manual canister loading and unloading
- Supply system: detection of empty or pre-empty canister
- Waste system: detection of canister overfull, full and pre-full

3.8 PC and software

- Industrial PC with touchscreen
- Password protected user levels (operator / process / service)
- Recipe editor and scheduler
- Automatic, manual and stop modes
- Mandatory process data logging
- Exportable batch, alarm and parameter logs

3.8 Additional requirements

- Compatibility with cleanroom operation (ISO 6 or better)
- System shall ensure minimal thermal load and avoid crack formation or damage to the glass substrate
- Capability to maintain high structural quality (low defectivity, absence of microcracks) suitable for subsequent metallization and optical integration
- Delivery of onsite training of the wet etching processes required after laser exposure to implement LIDE processing
- The manufacturer must have the capability of performing hydrodynamic studies to help optimizing the etching and e-less process in case we need in the future (service cost not included here)
- The manufacturer must show proofs that a system with similar characteristics have been used for TGVs fabrication

Software requirements

1. The system must include the software required to manage all required functionalities and capabilities described above and shall be supplied with a permanent (non-expiring) license.
2. The software shall be installed on the system.
3. Software backup must be included.

Technical documentation or manuals to be delivered

A set of documentation shall be provided, covering the following topics:

- Comprehensive system user manual, including both hardware and software descriptions, routine servicing and troubleshooting.
- Datasheets, technical brochures, or equivalent official manufacturer documentation describing the proposed equipment, demonstrating compliance with each of the minimum mandatory technical requirements set out in Clause 3 of this Technical Specification Sheet. Failure to provide sufficient documentation to verify compliance with any minimum mandatory requirement may result in the exclusion of the tender.
 - Automatic evaluation criteria: The tenderer shall only be required to provide supporting documentation for those automatically evaluable criteria set out in Annex 2 of the Administrative Clauses that ICFO expressly identifies as requiring documentary substantiation, and only in respect of the specific improvements that the tenderer chooses to offer. No documentation shall be required for criteria or options that the tenderer does not offer. Documentation not submitted within the tender deadline for a criterion that the tenderer has chosen to offer cannot be supplemented at a later stage, and the corresponding criterion will be scored as not offered.

CLAUSE 4. Power distributions and safety

- The system should be configured for EU (Spain) power grid (voltage, sockets, etc.) and be CE marked.
- Component wiring routed to a centralized power distribution panel.
- EMO protection.
- Appropriate hardware and software safety interlocks. Extended error diagnostics.

- The system will be fully protected against unexpected power cuts and, in that case, will be fully safe for the operators. A quick and easy turning on of the system has to be possible after a power cut.

CLAUSE 5. System layout and services

The proposal shall include a set of “system layout and services documentation”, containing the following information:

- System layout, including overall footprint, weight, drawings and detailed description of the different system components.
- Installation and start-up requirements, including required utilities, service connections, and any applicable environmental specification.

CLAUSE 6. Transportation, installation, start-up and training

- Contract includes the installation and start-up of the system, including system checking, functional tests and the supply of all those elements necessary for its correct operation
- The proposal will include transportation to ICFO's facilities including insurance and all export/import and customs duties.
- Any other customs or miscellaneous expenses, unexpected and not covered in the tender, which may arise until the equipment arrives at ICFO, must initially be borne by the Supplier and will be reimbursed by ICFO upon submission of supporting documentation proving the actual incurrence of such expenses.
- The machine will be placed in the designated location by ICFO. The contractor shall cover all costs, organization, and coordination related to the placement, including the provision of any required specialized equipment or vehicles, as well as any necessary component disassembly and reassembly for unloading and transportation inside the building, strictly following the route specified by ICFO.

Designated location has level, step-free access. Delivery using a truck equipped with a loading ramp or liftgate, together with appropriate wheeled handling equipment, is recommended to facilitate safe installation.

The access to the designated area is done through doors with maximum a height of 2 m.

- The contractor will be responsible for the removal and proper disposal of the packaging when the machine is delivered and unpacked, or its storage during the warranty period in case the original packaging needs to be kept.

Process qualification

A Factory Acceptance Test (FAT), or pre-acceptance test at the supplier's premises, shall be conducted prior to shipment (ICFO attendance at the FAT is not required). A Site Acceptance Test (SAT) shall be performed following installation of the equipment at ICFO's facilities. Successful completion of the SAT shall constitute the basis for final acceptance of the equipment.

Final acceptance of the system will be granted upon successful completion of the following technical demonstration:

1. Verification and validation of all relevant machine parameters demonstrating full compliance with the Technical Specification, such as circulation flows, baths temperature control and stability, baths filling and draining, etc.
2. Demonstration of TGV and cavity etching processes, representative of typical system performance. Materials (glass wafer and chemicals) and laser irradiation process shall be provided by ICFO, in agreement with the system supplier.
3. Demonstration of electroless copper seed metallization, representative of typical system performance. Materials (glass wafer and chemicals) shall be provided by ICFO, in agreement with the system supplier.

Protocol in the event of SAT failure and remediation deadlines.

Should the equipment fail any of the tests or verifications established in the SAT, the following protocol shall apply:

1. Formal notification of failure (Day 0): ICFO shall notify the contractor in writing and through a verifiable channel of the deficient results obtained, specifying in detail the parameters that did not meet the required values and attaching the corresponding measurement reports.
2. Corrective Action Plan (deadline: 5 working days from notification): the contractor shall submit to ICFO a written corrective Action Plan, identifying the root cause of the non-compliance, the proposed corrective measures, and an implementation schedule not exceeding 30 calendar days from the date of failure notification.
3. Re-execution of the SAT (deadline: maximum 30 calendar days from notification): once the corrective measures have been implemented, the contractor shall repeat the SAT in the presence of ICFO technical staff, within the aforementioned deadline. All costs associated with this repetition shall be borne entirely by the contractor.

CLAUSE 7. Warranty and Follow-on Support

- **1-year Full Warranty** on all parts and components of the system irrespective of the manufacturer. The warranty will include the replacement of any faulty or damaged part(s) during normal use of the system, no matter the manufacturer of the component(s). It will cover any cost related with the disassembly, transportation, reparation and re-assembly of the damaged component(s), including all travelling and living costs of the required service engineer(s). An on-site repair, or a justified alternative to reduce the system down time to the minimum, will always be the first service option. A team of properly qualified and skilled service engineers will have to be available.
 - The warranty period shall start from the date of signature of the formal acceptance certificate (*Acta de Recepción*) issued by ICFO upon successful completion of the Site Acceptance Test (SAT).
- System maintenance support available during, at least, 10 years, including access to technical assistance. The supplier shall provide feedback from a qualified technical specialist within 5 working days.
- Spare parts will be available during, at least, 10 years after system supply.
- An estimation of the cost of warranty extension options or available support contracts after the warranty period shall be included in the technical offer submitted.

CLAUSE 8. Training

- The contract includes mandatory training for ICFO staff, comprising a minimum of one (1) full working day for at least two (2) ICFO users, to be scheduled on a mutually agreed date.
- Training shall cover both system operation and process development, and shall take place at ICFO's facilities.

CLAUSE 9. Delivery and Installation Time

- The maximum execution period of the contract shall be **TWELVE (12) MONTHS**, counted from the day following the date of its formalisation.
- Within this period, the supplier must complete the manufacturing, transportation, delivery, installation, integration, commissioning of the system, and the execution of the Site Acceptance Tests (SAT). The delivery time shall therefore be understood as the full period required to complete all contractual obligations up to the successful acceptance of the equipment at ICFO facilities.

CLAUSE 10. Tender budget

- The tender budget (maximum bid price) for the supply is **2.620.000,00 €** (VAT excluded).
- The contractor may choose between two payment structures upon contract award:
 - Option A: Phased Payments (with Advance Guarantee)
 - 30% Advance Payment (Pago a cuenta): Upon official order placement for preparatory works. *Condition*: The contractor must provide a financial guarantee/bond equivalent to the advanced amount. This payment does not imply compliance or final acceptance.
 - 70% Final Payment: Upon delivery, commissioning, training, and formal signing of the Acceptance Report (*Acta de Recepción*).
 - Option B: Single Final Payment
 - 100% Total Payment: Disbursed in a single payment after full delivery, commissioning, training, and the formal signing of the Acceptance Report (*Acta de Recepción*).

CLAUSE 11. Environmental clause

It is hereby stated that, in compliance with the provisions of the Recovery Plan, Regulation (EU) 2021/241 of 12 February 2021 establishing the Recovery and Resilience Facility, and its implementing regulations, in particular Commission Communication (2021/C58/01) Technical guidance on the application of the principle of “do no significant harm”, as well as the requirements of the Council Implementing Decision concerning the approval of the assessment of Spain’s Recovery and Resilience Facility (RDF), all financed actions carried out under this contract must respect the principle of not causing significant harm to the environment (the “Do No Significant Harm” principle). This includes compliance with the specific conditions set out in component 17, measure I1, under which this contract falls. During the execution of the actions covered by the contract, no significant damage will be caused to the environment, in accordance with Article 17 of Regulation (EU) 2020/852.

The activities carried out will not cause direct environmental impacts, nor will they have primary indirect impacts throughout their life cycle, understood as those that may materialize once the activity has been completed.

The activities carried out by the successful bidder under this contract will not generate waste that, in its long-term disposal, could cause environmental damage, as this is one of the situations excluded from funding by the Recovery, Transformation and Resilience Plan, in accordance with the Technical Guidance on the application of the principle of “not causing significant harm” under the Regulation on the Recovery and Resilience Facility (2021/C 58/01), the Council's Proposal for an Implementing Decision on the approval of the assessment of Spain's recovery and resilience plan, and its annex. The activities carried out by the successful bidder will be adapted, where appropriate, to the characteristics set for the measurement and sub-measure of the assigned component, and reflected in the Recovery, Transformation and Resilience Plan.

The activities carried out will comply with all applicable environmental regulations in force.

For the transport, installation, and commissioning of the equipment covered by this contract, the contractor will implement waste minimization measures and, should any waste be generated, will be responsible for its collection, preparation for reuse, recovery, or recycling, or appropriate treatment.

Methods for monitoring and controlling compliance with the conditions

With regard to compliance with environmental and social requirements, the contractor remains obligated to:

- The contractor must sign, before the contract is formalized, the declaration of commitment regarding the implementation of actions under the Recovery, Transformation, and Resilience Plan (RTRP) and compliance with the principle of not causing significant harm to the environment, included as Annex of the Special Administrative Clauses.
- Issue a manual detailing the dismantling instructions for the equipment, including the reuse, recovery, or recycling operations, or appropriate treatment, including the disposal of fluids and selective treatment, applicable to each of the materials or parts that comprise it. The manual must include a table summarizing, expressed as a percentage by weight, the expected fate of the materials that make up the equipment at the end of its useful life, according to the following options: reuse (including recovery and recycling), energy recovery, and rejection/disposal.
- For the transport, installation, and commissioning of the equipment covered by the contract, the contractor will implement waste minimization measures and, should any waste be generated, will be responsible for its removal and management.

Castelldefels, on the date of its digital signature

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