Procurement of a vacuum-cluster deposition system for the thermal evaporation of metallic, organic and hybrid compounds.

Summary

The system is to be used for the deposition of organic, metallic and hybrid (e.g. organo-metal-halide perovskites) layers by means of thermal evaporation (TE). For this purpose, three physical vapor deposition (PVD) chambers are to be connected via a vacuum distribution and transfer system, capable to move sample carriers between PVD chambers without vacuum breaking. Two of the PVD chambers are to be suited for TE of perovskite materials such as caesium lead iodide or formamidinium lead iodide. The third PVD chamber is to be equipped with high-temperature TE sources (for e.g. Ag, Au, Cr, Ca, MoOx) and low temperature sources for organic compounds (e.g. small molecules, C60). All PVD chambers should be accessed through nitrogen glove boxes for loading and maintenance. A fourth nitrogen glove box is to be connected directly to the distribution system for loading/unloading of samples and in addition should be suited to perform solvent-based deposition of thin layers, e.g. via spin coating.

PVD chambers for hybrid material evaporation (Perovskites)

The system should comprise two PVD chambers that are specifically optimized for the TE of perovskite materials and feature a wedge mask for combinatorial sample processing.

Technical specifications: Perovskite PVD chamber	
Growth chamber	• Corrosion resistance stainless steel (SS304L) • Box type, flange connection to glovebox wall • Front access slide door with two viewports at source and sample height • Rear access hinged door for maintenance • Full range pressure gauge (atm to < 10E-8 mbar)
Base pressure	• Mid 10E-8 mbar range
Pumping speed	• < 20 min, range in 10E-6 mbar • < 30 min, range in 10E-7 mbar
Pumping group	• ≥ 35 m^3/h primary pump, oil free • ≥ 1200 L/s turbopump • Bypass for securing turbopump and optimizing venting & pumping cycles • Turbopump located at lower side of chamber, outside evaporation cone • Water-cooled baffles in front of exhaust to protect pump from corrosive vapors • Software controlled pumping and venting cycles
Chamber temperature control	• Double walled vacuum insulated shroud • Temperature-controlled flow of water -40°C to +90°C (external chiller provided by customer) • Water pressure limit switch (max. 2 bar)
Evaporation sources	• Source flange equipped with min. 8x DN40CF 2cc point sources • Individual adjustable shutters for all sources

	• Temperature range: 50 to 800 °C • Sources water-cooled • Water-cooled shields to prevent cross contamination • Type K thermocouples • Conical alumina crucibles • 8 x 400W power supplies for low temperature sources • Loading sources with material must be possible from within the glovebox
Crystal sensor	• 8 x Film thickness and deposition rate quartz sensors used for feedback-driven rate control • Water cooled • Each attributed to its specific cell • Double quartz sensors with flipping shield • Deposition rate reading precision 0,01 Å/s • Incl. controller for sensors and sources; for closed loop feedback (PID) driven high precision regulation of source power
Substrate holder and manipulator	• Min. 150 mm by 150 mm square sample plate • Accommodate at least 25 samples (sample size 12 mm x 12 mm) • Height adjustable by manually exchanging sample carrier • Sample holder rotation 0-30 rpm • Substrate shutter • Substrate temperature regulation, heating (> 300 °C) & water cooling. Incl. thermocouple for temperature monitoring and regulation in software (± 1 °C) • With co-rotating wedge/blade mask. Two independently actuated blades shall allow to expose/shield the samples row by row. • Compatible with automatic loading/changing of samples and masks
Maintenance safety	• Mechanical mounting frame around service door to attach customer-provided cover for maintenance
Supervision	• PLC-based software interface for full process control: substrate preparation, evaporation process (recipe-based processes incl. multiple steps, co-evaporation, sequential evaporation), substrate heating during and after deposition, transport of mask and samples • Definition of row-by-row parameters for combinatoric processes using the wedge/blade mask • Saving/Loading previous experiments • Visualization and recording of process parameters (Deposition rates and thickness, pressure, power, system status) • Additional points will be awarded for a system with a single central PLC-based software that controls all components, incl. the central distribution chamber, the storage chamber, the load lock and the PVD chambers and processes

PVD chamber for metal and organic evaporation

The system should further include one PVD chamber equipped with low and high temperature sources for the thermal evaporation of metals and organic compounds, respectively.

Technical specifications: Metal/Organic PVD chamber	
Growth chamber	• Corrosion resistance stainless steel (SS304L) • Box type, flange connection to glovebox wall • Front access slide door with 2 viewports at source and sample height • Rear access hinged door for maintenance • Full range pressure gauge (atm to < 10E-8 mbar) • Side wall liners
Base pressure	• Mid 10E-8 mbar range
Pumping speed	• < 20 min, range in 10E-6 mbar • < 30 min, range in 10E-7 mbar
Pumping group	• ≥ 35 m^3/h primary pump, oil free • ≥ 1200 L/s turbopump • Bypass for securing turbopump and optimizing venting & pumping cycles • Turbopump located at lower side of chamber, outside evaporation cone • Software controlled pumping and venting cycles

Evaporation sources	• Source flange equipped with
	  ○ 2 x DN40CF 2cc point sources, 50 – 800 °C
	  ○ 4 x Joule effect evaporation boats, up to 1700 °C
	  ○ 4 tapped flanges spare
	• Individual adjustable shutters
	• Low temperature sources water-cooled and with Type K thermocouples
	• Water cooled high voltage feedthroughs
	• Shields to prevent cross contamination
	• 2x power supplies for high temperature sources
	• 2x power supply for low temperature sources
	• Loading sources with material must be possible from within the glovebox

Crystal sensor	• 6 x Film thickness and deposition rate quartz sensors used for feedback-driven rate control. Water cooled and each is attributed to its specific cell • Deposition rate reading precision 0,01 Å/s • Incl. all controller for sensors and sources; for closed loop feedback (PID) driven high precision regulation of source power
Substrate holder and manipulator	• At least 150 mm by 150 mm square sample plate • Accommodate at least 25 samples (sample size 12 mm x 12 mm) • Fixed height • Sample holder rotation 0-30 rpm • Substrate shutter • With co-rotating wedge/blade mask. Two independently actuated blades shall allow to expose/shield the samples row by row.

	• Compatible mask automatic loading/changing of samples and masks
Supervision	• PLC-based software interface for full process control: substrate preparation, evaporation process (recipe-based processes incl. multiple steps, co-evaporation, sequential evaporation), transport of mask and samples • Visualization and recording of process parameters (Deposition rates and thickness, pressure, power, system status) • Definition of row-by-row parameters for combinatoric processes using the wedge/blade mask • Additional points will be awarded for a system with a single central PLC-based software that controls all components, incl. the central distribution chamber, the storage chamber, the load lock and the PVD chambers and processes

Automated distribution and transfer vacuum system

The PVD chambers shall be connected through a central distribution system, allowing to transfer samples without vacuum breaking. The transfer is fully automated. The system is to be designed in two parts, which are connected, but can be sealed from and operated independently of each other (e.g. for maintenance). An additional sample storage compartment should be accessible from both parts.

Technical specifications: Automated distribution and transfer vacuum system	
Transfer chamber	• Stainless steel • Viewports with cameras • Min. 4 main ports + 4 secondary ports • Maintenance access flanges • One fast entry load lock accessible from glove box capable to load min. 6 sample carriers or masks at once • Rotary telescopic transfer arm able to reach PVD chambers and storage chamber
Storage chamber	• Min. 6 storage positions for masks and sample carriers • Viewports with cameras • Lamp heater for up to 150 °C
Base pressure	• Mid 10E-8 mbar range
Pumping group	• ≥ 15 m^3/h primary pump, oil free • ≥ 900 L/s turbopump • Bypass for securing turbopump and optimizing venting & pumping cycles • Software controlled pumping and venting cycles
Supervision	• PLC-based software control system • Configuration of multiple processing steps for single substrate carrier, including multiple depositions across different PVD chambers; incl. combinatoric depositions using wedge/blade mask; automatic exchange of masks according to recipe • Automatic and manual scheduling of depositions should be possible

	• Safety interlock between all components, incl PVD chambers, glovebox, load lock and central distribution chamber • Remote access to PC possible for monitoring, process control and setup of experiments • Additional points will be awarded for a system with a single central PLC-based software that controls all components, i.e. the central distribution chamber, the storage chamber, the load lock and the PVD chambers and processes

Nitrogen glove boxes

The deposition cluster is to be designed with a total of four nitrogen glove boxes. Three gloveboxes (henceforth PVD-GB) are connected to the PVD chambers and allow sample and material loading, as well as maintenance, from a nitrogen atmosphere. An additional glovebox (henceforth Transfer-GB) is connected to the fast load lock of the central distribution and transfer system. The Transfer-GB is further suitable to carry out solvent-based processes.

Technical specifications: Nitrogen glove boxes	
GB size	• 3x Two gloves for PVD chamber boxes • 1x Four gloves for load lock and solvent-based techniques, e.g. spin coating (coater provided by customer)

Atmosphere control	• Nitrogen
	• Achievable purity values: < 1ppm O2 and H2O
	• Monitoring of O2 and H2O
	• Automatic inertization of the glovebox based on H2O values
	• Adjustable alarm for O2 and H2O levels
	• Automatic pressure control of the glovebox
	  o Overpressure and underpressure
	• Fully automatic gas filter regeneration process
	• Solvent absorber with activated carbon
	  o Exchangeable activated carbon
	  o Equipped with bypass valves
	  o Conditioning via vacuum pump
	  o Stand-alone system, portable, mobile

Antechambers	• Small AS: ø 150 mm • Large AS: ø 400 mm
Pumps and accessories	• Incl. all accessories such as pumps, tubing, valves, caps, …

Support, service and warranty

Installation and Training	• Installation at IFW
	• Proof of functionalities
	  o Vacuum and atmosphere purity levels
	  o Sample and mask handling, transportation, transfer into PVD and storage chambers
	  o Deposition of all material classes (materials provided by customer)
	• Training
	  o System start-up and safe shut-down

	○ Maintenance training (administrator and operator level) and troubleshooting ○ Software training ○ Loading of materials, masks and samples ○ Recipe creation and process steps ○ Maintenance of vacuum system and glove boxes
After sale support	• ≥ 12 months warranty • 18-h support via phone or mail • On-site service possible < 72 h • User manual for complete system and components • Guaranteed operation of IT components for min. 15 years, incl. software updates, hardware replacement/upgrades.

Regulations of the assignment procedure/Contact person

Mrs. Kristin Schwencke via eVergabe

Terms of delivery

Only brand-new, original products of the manufacturer are to be supplied, which are approved in the EU and comply with local safety standards. The deliverability of the offered equipment must be fully secured from the beginning of the contract. Delivery must be feasible by the end of 12/2024.

Delivery place:

IFW Dresden e. V.

Helmholtzstr. 20

01069 Dresden

Germany

Delivery date: Until December 2024

Specification: ……..actual delivery date.

Disposal:

Environmentally-friendly packaging and recyclable goods are assumed. The free return of packaging and old equipment from internal production for environmentally friendly disposal by a specialist company must be carried out by the supplier within three working days after information by the customer. The contractor shall provide evidence of environmentally-friendly disposal in accordance with the statutory requirements as requested by the client.

Prices and terms of payment:

Advance payments (payment before acceptance) are only possible if they are customary in the industry. For this purpose, the following shall apply as payment modality:

o max. 70% of the order value after receipt of the order confirmation and invoicing (in accordance with Section 56 Federal Budget Code and Section 56 Saxon Financial Code in connection with Section 17 (1)(2) VOL/B) – 14 days with deduction of cash discount or within 30 days net without deduction

o final payment of the order value after successful acceptance and after presentation of a verifiable invoice in accordance with the agreed term of payment

o advance payments shall only be made after presentation of a valid bank guarantee issued to IFW Dresden for an unlimited period free of charge and recognised by IFW Dresden as such, which is provided by a credit institution authorised in the European Union and accepted by IFW Dresden

The prices used are fixed prices and refer to the designs offered for the respective items, including delivery and packaging free place of performance and any customs duties.

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(Place, date) Name, stamp, legally binding signature)