

Annex F - Site acceptance tests for PLD research cluster basis

All supplied components of the PLD research cluster basis shall be tested on their intended functionality and the requirements stated in Annex - PLD research cluster reference design and system specification.

The tenderer is required to reproduce the experimental deposition data requested within Annex – PLD award criteria, with the PLD research cluster basis. The results shall be equal or better.

In addition, the following site acceptance tests need to be performed:

Transfer-line

1. Pressure tests:
 - a. A base pressure of at most $7 - 9 \times 10^{-8}$ mbar and $1 - 3 \times 10^{-8}$ mbar shall be reached after pumping down for at most 24 h and 48 h, respectively.
 - b. The load-lock shall achieve a pressure of at most $5 - 8 \times 10^{-7}$ mbar within 2h when pumping down from ambient pressure.
2. Operational tests
 - a. Transportation of substrates including loading and unloading of substrates into the transportation cart.
3. Data acquisition
 - a. Data acquisition by DIFFER's CODAC system shall be tested w.r.t. the requested parameters within Annex – PLD - award criteria.
4. Safety tests
 - a. Interactions with DIFFER's lab safety system shall be tested, such as the automatic shutdown of the bake-out system in case of a fire alarm and automatic process control for bringing the system in a safe operational state in case of fire or evacuation alarm.

Small and large area PLD systems

1. Pressure tests
 - a. A base pressure of at most $7 - 9 \times 10^{-8}$ mbar and $1 - 3 \times 10^{-8}$ mbar shall be reached after pumping down for at most 24 h and 48 h, respectively.
 - b. The target load-lock shall achieve a pressure of at most $5 - 8 \times 10^{-7}$ mbar within 20 min when pumping down from ambient pressure.
 - c. The processing pressure, at which the PLD deposition is carried out, shall stabilize with less than 1 % deviation from two processing pressure set points of 0.1 mbar and 0.01 mbar with 50% O₂ gas and 50% Ar gas (mass percentage) within less than 5 min.
 - d. A pressure of at most $5 - 8 \times 10^{-7}$ mbar shall be reached within 20 min when pumping down from the processing pressure of 0.1 mbar with O₂ gas.
2. Motion stage accuracy, repeatability and stability tests

For both systems these tests shall be performed with a 0.5 mm thick 10x10mm SrTiO₃ (100) single crystal substrate. RHEED detector screen and camera setup shall remain constant.

 - a. The RHEED pattern in the direction SrTiO₃[001] as shown in Figure 1 shall be obtained such that the optimized maximum intensity of the (00) peak,

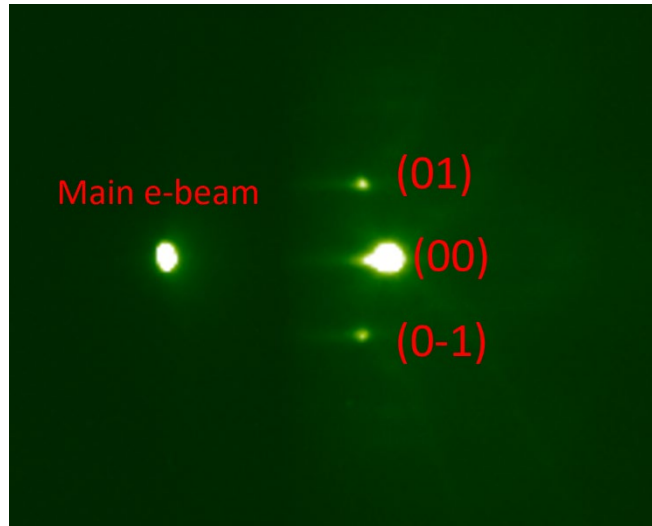


Figure 1 - RHEED pattern of $\text{SrTiO}_3(100)$.

the (01) and the (0-1) peaks which shall be symmetrical around the (00) peak, and the main e-beam on the $\text{SrTiO}_3(100)$ substrate are visible on the detector screen of RHEED.

- b. After alignment of RHEED, the substrate motion stage shall move (>50% of the range of motion) in all degrees of freedom and shall automatically return to the alignment position such that the RHEED pattern re-appears on the RHEED detector screen within N_{error} pixels of its original position. Where N_{error} is the number of pixels equivalent to a positional error of the substrate of 20 μm .
- c. After alignment of RHEED at 300°C, the substrate shall be heated to the respective maximum temperature. During the heating process, the RHEED pattern shall shift at most N_{error} pixels on the RHEED detector screen. Where N_{error} is the number of pixels equivalent to a positional error of the substrate of 20 μm .

3. Growth tests

- a. Two different thin films of SrRuO_3 and LaNiO_3 must be successfully grown on two 0.5 mm thick 10 x 10 mm² $\text{SrTiO}_3(100)$ single crystal substrates at the following growth conditions and their film growth must achieve layer-by-layer mode, monitored by RHEED, with clear oscillations in intensity of (00) peak in their RHEED patterns. The plasma plume centre shall be aligned with the centre of the substrate.

The growth condition for SrRuO_3 :

Pressure: 0.13 mbar O_2
 Substrate temperature: 700°C
 Laser fluence: 2.1 J/cm²
 Spot size: 1.8 mm²
 Laser repetition: 2 Hz
 Target-substrate distance: 50 mm

The growth condition for LaNiO_3 :

Pressure: 0.04 mbar O₂
Substrate temperature: 450°C
Laser fluence: 1.9 J/cm²
Spot size: 1.8 mm²
Laser repetition: 2 Hz
Target-substrate distance: 50 mm

4. Geometric compliance
 - a. Flange alignment and flange sizes for all in-situ diagnostic tools must be proven as same as they are agreed upon and designed. The supplier can choose a method to proof this.
5. Data acquisition
 - a. Data acquisition by DIFFER's CODAC system shall be tested w.r.t. the requested parameters within Annex – PLD - award criteria .
6. Safety tests
 - a. Interactions with DIFFER's lab safety system shall be tested such as the automatic shutdown of the bake-out system and heating system in case of a fire alarm and automatic process control for bringing the system in a safe operational state in case of fire or evacuation alarm.

Small area PLD system specific

1. Temperature tests:
 - a. The sample temperature of 0.5 mm thick 10x10 mm² Si and SrTiO₃ substrates, glued on the sample holder by silver paste, must achieve 1000°C, 700°C and 300°C from 25°C within 20 min and must be stabilized with +/- 1°C at these temperatures within less than 5 min. The pyrometer is used to measure the sample temperature.

Large area PLD system specific

1. Temperature tests:
 - a. For the radiative heating in large PLD chamber: The sample temperature of 0.5 mm thick 4 inch in diameter Si substrates, glued on the sample holder by silver paste / hold by a wafer carrier ring (direct heating of the substrate), must achieve 900°C, 700°C and 300°C from 25°C within 35 min and must be stabilized with +/- 2°C at these temperatures within less than 10 min. The pyrometer is used to measure the sample temperature.
2. Growth test
 - a. A 4-inch wafer thin film of 100 nm thick crystalline Yttria-stabilized Zirconia with/without buffered layers on Si shall be successfully grown with less than 5 % variance in film thickness across the diagonal of the wafer.

Sputter system

1. Pressure tests
 - a. A base pressure of at most $7 - 9 \times 10^{-8}$ mbar and $1 - 3 \times 10^{-8}$ mbar shall be reached after pumping down for at most 24 h and 48 h, respectively.
 - b. The processing pressure, at which the deposition is carried out, shall stabilize with less than 5 % deviation from two processing pressure set points of 0.1 mbar and 0.01 mbar with Ar gas within less than 5 min.

- c. A pressure of at most $5 - 8 \times 10^{-7}$ mbar shall be reached within 20 min when pumping down from the processing pressure of 0.1 mbar with Ar gas
- 2. Deposition test
 - a. A 4-inch Si wafer shall be coated with a 40 nm Pt contact layer with less than 5 % variance in layer thickness across the diagonal of the wafer.
- 3. Data acquisition
 - a. Data acquisition by DIFFER's CODAC system shall be tested w.r.t. the requested parameters within Annex – PLD - award criteria.
- 4. Safety tests
 - a. Interactions with DIFFER's lab safety system shall be tested such as the automatic shutdown of the bake-out system case of a fire alarm and automatic process control for bringing the system in a safe operational state in case of fire or evacuation alarm.

Ablation laser system

- 1. Data acquisition
 - a. Data acquisition by DIFFER's CODAC system shall be tested w.r.t. the requested parameters within Annex – PLD - award criteria.
- 2. Safety tests
 - a. Interactions with DIFFER's lab safety system shall be tested such as the automatic shutdown of the bake-out system case of a fire alarm and automatic process control for bringing the system in a safe operational state in case of fire or evacuation alarm.