The new PSI metallography-box

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Abstract

The design of a fully new metallography-box for the PSI hot-laboratory was started in 1998 and the concept finalised in 1999. After analysis of the offer from different European manufacturers, a Swiss company has been chosen for the realisation of the shielded box. The construction has started in 2001 and has been completed in June 2002.

The new metallography-box includes two separate shielded areas: one for the preparation and storage of the specimens (preparation-box) and the second for the microscopic analysis of the specimens (microscopy-box). The transfer of the specimen from one box to the other is realised with a rotating shielded lock.

This paper contains a short resume of the preparatory work to the construction of the box, including the dismantling of the old metallography box, and the reinforcement of the laboratory floor. Then the concept of the new box is presented and special features of the box are described.

Finally the schedule for the set up of the metallography box is presented.

1. Introduction

After more than 25 years of service, the old PSI shielded metallography box was dismantled and a new one designed and constructed. The conceptual design of the new box was started in 1999 and the order of the main component was realised in 2001. The construction took about one year and the box is now in the setting up phase.
This paper presents shortly all steps of the construction of the box and light up some special features of the new box.

2. Dismantling of the old metallography box

The dismantling of the old metallography box started with the dismantling of all infrastructure of the box. Most of it was so much corroded (Fig. 1) that the instrument had to be cut in part with a small electric saw. When empty, the inner surfaces of the box have been cleaned mechanically first and then by light etching. This allowed reducing sufficiently the radioactivity of the box for the dismantling of the shielding (Fig. 2).
At this point all locks have been removed and the openings sealed with covers (Fig. 3). Finally the inner box was sealed in a stainless steel container for storage (Fig. 4). The final cutting of the contaminated box is not yet possible in PSI, because the decommissioning box is still not licensed to work with α-contaminated materials.
The dismantling of the box took about one year and the total accumulated dose by the PSI collaborators during this work was 3.1 mSv.

3. Preparation of the laboratory

The new box is larger than the old one and the total weight of the shielding has been increased by about 60% (from 50 ton to 80 tons). The floor of the laboratory had to be reinforced to sustain this extra weight. It was decided to support the floor with a pile in the cellar (Fig. 5). But the cellar floor itself was so weak, that it had also to be reinforced by microfilling. This consisted to drill holes, 2.5 m deep, in the cellar floor and fill them with high density concrete.
A quite large drilling machine has been installed in the cellar (Fig. 6) and microfilling realised (Fig. 7). Finally a steel pile has been adapted to the existing infrastructure (Fig. 8).

Fig. 1 Cleaning of the inner surface of the α-box

Fig. 2 Dismantling of the shielding of the old metallography box

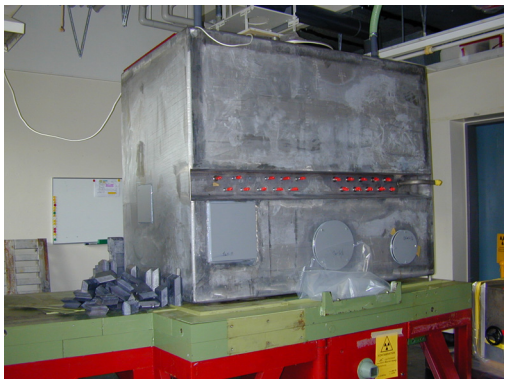

Fig. 3 Sealed α-box ready for transport

Fig. 4 Old metallography box in its storage container

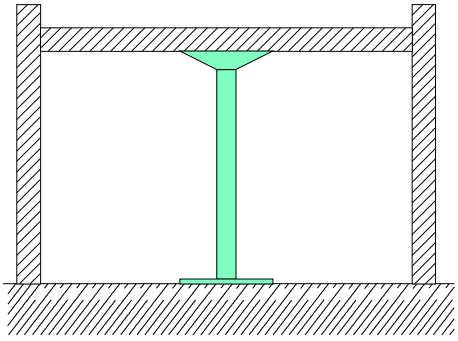

Fig. 5 Concept of the laboratory floor support

Fig. 6 Drilling machine for the microfilling

Fig. 7 Microfilling in cellar

Fig. 8 Pile in final position

4. Concept of the new metallography box

The concept and basic design of the box was realised in PSI. The concept is based on two α-tight shielded boxes, one large for the specimen preparation and one small for the microscope (Fig. 9).

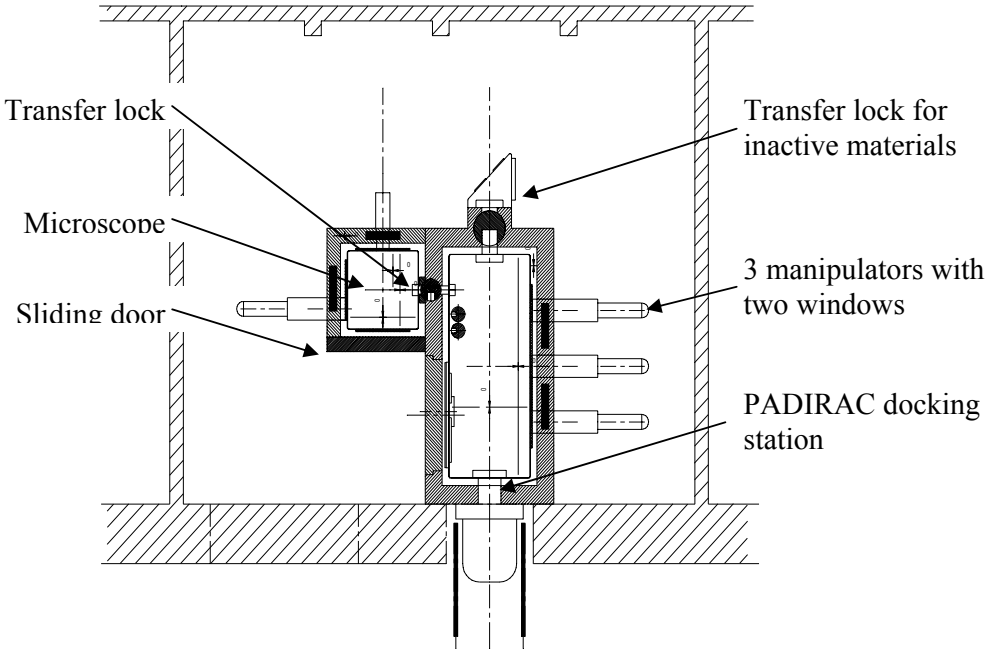

Fig. 9 Concept of the new PSI metallography box

Both α-boxes can be filled with air or nitrogen and are linked by a rotating lock. On one side of the box, a transfer lock for inactive material is installed. This allows an easy, fast and safe transfer of consumable materials as polishing cloth or embedding product. This lock is based on a La Calhène DPTE double door system. The microscopy box is large enough to allow upgrade of the microscope accessory in the future and the shielding can be easily opened (few minutes) for the service of the microscope. A lock for the docking of PADIRAC transport shielding is installed on the second side of the box.

5. Special features of the preparation's box

The bid for the construction of the box was won by a local Swiss firm (Meto-Bau in Würenlingen). The fabrication of the elements has started in 2001 and completed in beginning of 2002. The final assembling in the PSI laboratory was completed in summer 2002.
The shielding of the preparation's box is made of 25 cm steel (Fig. 11). The one of the microscopy box is only 20 cm thick. All internal elements as well as the locks are in stainless steel (Fig. 12, 13). The inner surfaces of the α-boxes are electro-polished (Fig. 14).

Fig. 10 α-Box for specimen preparation

Fig. 11 Shielding for the α-Box for specimen preparation

Fig. 12 Large rotating lock for inactive materials materials

Fig. 13 Transfer sas for inactive with rotating lock (right)

A shielded (5 cm Lead) storage place for up to 30 specimens is installed in the back of the preparation's box (Fig. 14). This allows minimising the specimen transfer from and to the main PSI hot cells during the execution of one project. The samples in the storage area are shielded with 5 cm lead. This allows maintaining a low dose rate in the box.
A large plate of the shielding can be removed to service the preparation's box (Fig. 16). This allows access to the connector plate where all gas, electric and liquid connection are located. A glove can also be mounted in this plate for small object manipulation in the α-box.
A docking door for the PADIRAC transport shielding has been installed on a side of the preparation's box. The PADIRAC cask is connected to the door through an opening in the laboratory wall (pre existing). The system has been checked with an empty PADIRAC shielding this summer (Fig. 17).
The dismantling and removing feasibility of the infrastructure was included in the concept of the new box. All machines in the box can be dismantled in small parts that can be transferred in our standard waste can (diameter 209 mm, length 504 mm). Special machines had to be developed or modified to insure dismantling in the box with manipulator like our polishing machine (Fig. 15).

Fig. 14 Specimen storage (cylinder), storage place and inner surfaces.

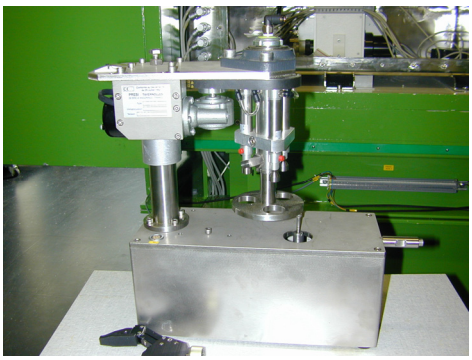

Fig. 15 Polishing machine

The main infrastructure of the box is composed of 2 polishing robots (modified PRESI machine), one saw (modified Buehler machine), a small ultra-sonic cleaner and 1 Struers low vacuum embedding system. An etching place, with reinforced ventilation will be made, in order to decrease the corrosion problem in the box.

Fig. 16 Large opening in the shielding for service the shielded purpose. Lower part with sample transfer ports (for PSI standard waste cans)

Fig. 17 PADIRAC transport cask and Transfer door on the metallography box

6. Special features of the microscope's box

The box has a sliding door that allows a very quick access to the microscope (Fig. 18, 19). Behind the sliding door a large removable window with two gloves will permit the cleaning and service of the microscope.
The microscope is a LEICA Telatom IV, a fully remote controlled instrument (Fig. 20, 21). It will be equipped with a high-resolution digital camera and a PC based picture acquisition, treatment and archiving system.

7. Actual state of the box and completion schedule

The boxes are fully built and are tight. All needed infrastructures for the preparation's box have been ordered and has been or is in course to be modified. We have already started the installation of the polishing machines and start the operation test with manipulators. The microscope is operational. Some local safeguards must still be installed in the microscope's box.
The regulation and safety device for the box ventilation will be installed in November and a safety report will be written. We hope to get the final authorisation for the operation with fuel beginning of next year.

Fig. 18 Closed microscope's box microscope

Fig. 19 Holder of the sliding door in the microscope's box

Fig. 20 Inactive part of the LEICA Telatom-IV microscope

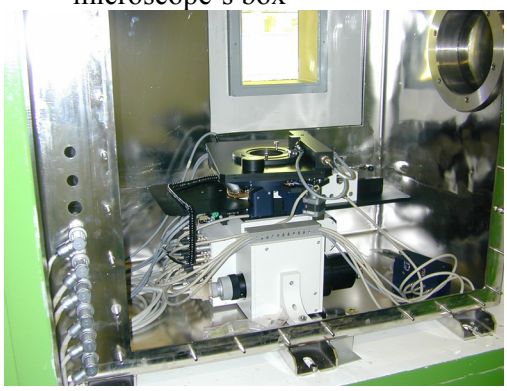

Fig. 21 Active part of the LEICA Telatom-IV microscope in its α-box