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Room-facelift for new JEOL JEM-ARM 200F instruments

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During the last decade there has been an immense progress in the field of transmission electron microscopy (TEM) development. Due to the application of aberration-corrected electron optics it is nowadays possible to perform structural and analytical investigations in the sub-nm range in TEM and STEM-mode.

At the same time, the environmental conditions in the TEM laboratories became more critical. The microscope manufacturer demands to have several requirements and room specifications to be fulfilled. As a consequence significant efforts have to be carried out to achieve all these parameters. The temperature constancy has to be better than 0.2° C/h, fluctuations of 0.05 °C/min or less. The air flow should be below 100 mm/s at the column position and the air humidity 60 % or less. The acoustic noise has to be less than 50 dB. Also the reduction of stray-magnetic fields (to < 20 nano-Tesla (DC and AC) is important. Mechanical vibrations should be kept as low as possible (< 0.2 µm for frequencies higher than 3 Hz).

In our case there are two laboratory rooms, which were built 11 years ago. At that time these rooms were equipped with the best available technology, but for the new generation TEMs the environmental tests failed the specified requirements. Neither the acoustics nor the other parameters were acceptable. Thus, an elaborate room-reconstruction procedure was necessary in order to meet all the requirements in the existing building. In the microscope rooms (Fig. 1), there are the TEMs, the high voltage tanks and water valve units. Everything else has to be outside in the engineering rooms (power supply units for lenses and correctors, camera and energy-filter controllers as well as water chillers, air compressors and further equipment).

For avoiding air-pressure fluctuations, which should be as small as 1 Pa or less during the measurement period, we had to install an airlock, which we use as an anteroom for both TEM laboratories. The microscope rooms are equipped with noise prevention doors. On the ceiling and on the walls of the TEM labs cooling panels are installed with a cooling efficiency of 3 kW for each room; additionally the texture of the surfaces of the walls is designed in a way such as to reduce acoustic noise. In order to keep air-flow speed and the acoustic noise of the air-conditioning system at low level air duct socks are used at the intakes. The microscopes themselves are mounted on concrete blocks of 40 tons each, which are completely isolated from the floor accessible to the user. An active compensation system for stray-magnetic fields using three pairs of Helmholtz coils is installed in each microscope room. Fiber-reinforced concrete (instead of steel reinforcement) is applied for the upper part of the microscopes' foundations in order to avoid interference with the compensating magnetic fields. In addition, one microscope (the TEM/STEM) is equipped with a passive damping system to minimize mechanical vibrations. In order to avoid stray-magnetic fields resulting from possible leakage currents in the power-supply lines for the peripherical electrical equipment these power lines are disconnected while the main laboratory light is switched off.

Figure 1. Room design for the new JEOL JEM-ARM 200F microscopes at the Stuttgart Center for Electron Microscopy