4 Slow Positron Facility

4-1 Research and Development of Transmission Positron Microscope

Introduction

New results have recently been reported [1-3] from studies using a positronium-time-of-flight spectrometer (Ps-TOF)[4]. The total operating time of the beamline was about 3000 hours in FY2005, during which five proposals and a cooperative research and development program were carried out. There are great prospects for a positron microscope in the facility, which is expected to facilitate challenging research in the near future. The linac-based intense slow-positron beam is expected to be effectively used for the positron microscope.

Transmission Positron Microscope

The advantages of transmission positron microscopes over transmission electron microscopes are as follows [5]:

(1) Positrons are repelled by positive ions and the inner shells of atoms, so that the scattering of positrons is weaker than that of electrons. Positrons are pulled into interstitial sites due to the Coulomb interaction. Compared to electron techniques images can be observed from thicker specimens, and there is less damage of the samples.

(2) In some cases transmission positron microscopes generate images with sharper contrast. Organic compounds or biomaterials are suitable targets for observation with transmission positron microscopes. These materials are often decorated by metallic ions to increase contrast, and contain open volumes which trap positrons effectively.

The slow-positron branch line for transmission positron microscopy is directed towards the ceiling of the basement. A working stage 5 m above the floor was constructed in March 2005. The slow positron guideline will be maintained on this stage. The Japan Electron Optics Laboratory (JEOL) transmission electron microscope (JEM100SX) formerly positioned at the southern end of the experimental hall has recently been moved to a position neighboring the Ps-TOF.

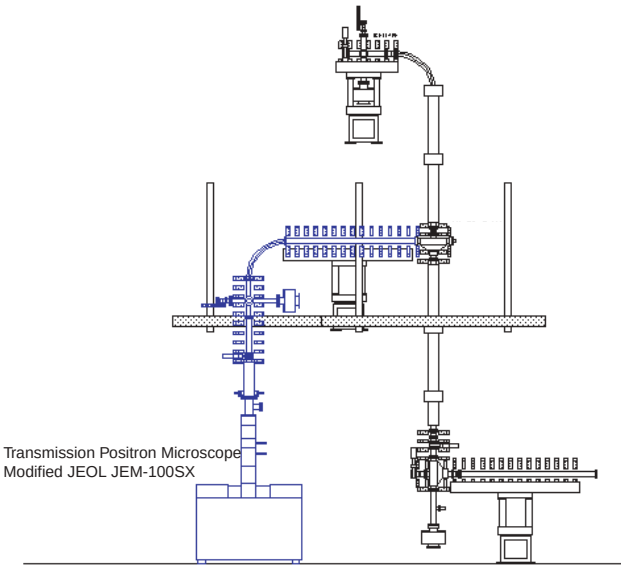

Figure 1
Slow-positron branch beamline for transmission positron microscopy (vertical plan). The blue line shows the planned beamline and equipment (to be installed during FY2006).

Figure 1 shows the slow-positron branch line for transmission positron microscope and the related experimental apparatus. The positron transport line is initially horizontal, directed vertically, and is then directed downwards to the transmission positron microscope. The high voltage cables used for the electron microscope have been replaced with the positron beamline. The positron beam will be focused at the previous location of the electron gun of the transmission electron microscope.

References

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[3] H. K. M. Tanaka, T. Kurihara and A.P. Mills, Jr., *the November 28, 2005 issue of Virtual Journal of Nanoscale Science & Technology, Section Chemical Synthesis Methods, the American Institute of Physics and the American Physical Society.*

[4] *Photon Factory Activity Report* **22A** (2004) 80.

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