The high-intense pulsed positron source MePS - recent developments and future plans

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The Helmholtz-Center Dresden-Rossendorf operates several user beamlines for materials research using positron annihilation energy and lifetime spectroscopy. The superconducting electron LINAC ELBE [1] serves as a driver for hard X-ray production from electron-bremsstrahlung, which in turn generates positrons through pair production. The Gamma-induced Positron Source GiPS directly generates electron-positron pairs inside the sample under investigation [2]. The source is especially suited for materials, which are not qualified for vacuum conditions or because they impose hazards or intrinsic radioactivity.

The Mono-energetic Positron Source MePS utilizes positrons with fixed kinetic energies ranging from 500 eV to 18 keV [3] for thin film studies, which allows depth profiling. A magnetic beam transport system guides positrons passing on the way chopping, bunching, and accelerator sections to the samples under investigation. The simultaneous operation of chopping and bunching techniques supported by digital acquisition generates nearly background and distortions-free spectra as well as offers timing resolution down to about 210 ps. One of the key features of the MePS system is the adjustable repetition frequency of the accelerator that enables for a wide selection of measurement time windows. As a result, long Ps lifetimes (up to the 142 ns limit) can be measured without any pulse pile-up. The improved digital data acquisition system that is required for the high throughput measurements will be presented.

In the second part, it is shown how the intensity profile of individual positron lifetimes can be used in combination with the implantation profile according to Makhov to determine layer thicknesses for insulating porous structures, to observe the extraction of porous layers on sodium borosilicate glass plates and to determine the pore sizes using a monoenergetic positron beam.

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