Project review

DEVELOPMENT OF THE EXPERIMENTAL TECHNIQUE AND APPLIED RESEARCH WITH MONOCHROMATIC POSITRON BEAM

The aim of the project is focused on applied research in the physics of solid matter, and engineering of materials and surfaces, using the method of positron annihilation spectroscopy (PAS) that is certainly an interesting and practically important task.

First of all, one should note the presented project contains some original technical approaches. For this reason, it is of professional interest for the reviewer.

PAS method in version of the Doppler broadening annihilation line measurement is developed and applied at Dzhelepov Laboratory of Nuclear Physics since 2013. This method allows studying samples of various materials, including defects created by implanted ions from the cyclotron of the FLNR.

In 2017 a digital positron annihilation lifetime spectrometer (PALS), which uses conventional ^{22}Na source, was mounted and commissioned that was used since that time to study the radiation effects in different materials.

The feature of the equipment is the positron flux of high monochromaticity (spectral width FWHM at the exit of the positron injector is 2.3 eV) and the possibility of varying the energy of the positrons on the target. The group upgraded the cryogenic source of monochromatic positrons, which was modified to a closed-cycle cooling with liquid helium from cryocooler. In 2019, ion source was installed, which allow one to perform experiments including ion etching. This increases measurement resolution and allow one to study the defects on deeper depths.

Specialized monochromatic positron transfer channel was constructed and commissioned in 2019 that was equipped with specialized vacuum chamber. It has independent vacuum system and remotely controlled device for moving a sample to be studied under the positron flux. All this shortened time of an experiment preparation and performance.

The further development of the facility is planned to equip the channel by apparatuses for forming an ordered flux of positrons (the method proposed by the group). Some part of the system – RF cavities, was designed fabricated and tested. All this allows us to hope for the fulfillment of the tasks planned by the group. Then, in the following year, opportunities for research by the PAS method will be significantly expanded by positron lifetime and coincidence Doppler broadening spectroscopies.

I propose to recommend the project to the prolongation, as it is of scientific and practical interest for JINR, Russia and JINR member-states.

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