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Materials Research Utilizing Pulsed Positron Beams at FRM II

Friday 6 December 2024 10:00 (45 minutes)

Atomistic defects and voids often determine the mechanical, electrical or optical properties of materials. Positron lifetime spectroscopy offers the unique potential to analyze and characterize vacancy type atomic defects, defect clusters and nanoholes in nearly any kind of material. Our institute has developed instruments that use pulsed, low energy positron beams to obtain best resolution and sensitivity for the analyzes of these vacancy type defects. Our positron instruments profit from the high intense positron source NEPOMUC at FRM II that offers the most intense low energy positron beam world-wide.

In the talk I will review the state of the art of our two instruments: the Pulsed Low Energy Positron Spectrometer (PLEPS) and the Scanning Positron Microscope (SPM). I will demonstrate the actual performance on the basis of characterization of different kind of materials including tungsten materials for fusion first wall materials, nano-membranes and metal organic frameworks. I will also show actual research questions on nitrogen-vacancy centers in diamond as discussed as a quantum material that wait for further insitu analysis for charging and discharging by insitu light illumination at PLEPS.

The development of the instruments is by far not yet finished: The SPM is still waiting for the first positrons on the positron research platform of NEPOMUC and its transfer to its new position in the east hall of FRM II. In addition, the quality of the positron beams and the instruments can still be improved enhancing quality of lifetime spectra, improving insitu manipulation (light, electrical fields) of samples, combining positron lifetime spectroscopy with momentum analysis of the emitted photons (AMOC: Age Momentum Correlation) and enhancing throughput. In addition, we are developing a high frequency post-accelerator to apply high energy pulsed positron beams with millimeter range to thick materials.

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