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Point defects in Nb-based superconducting films probed by positron annihilation spectroscopy

Thursday 25 September 2025 14:30 (3 hours)

Positron annihilation spectroscopy (PAS) is a powerful and precise tool to study atomic-scale defects in a wide range of materials, especially superconductors. The PAS methods available at the user facility radiation source ELBE (HZDR, Germany) enable analysis of point defects and their agglomerations including within the range of micro- and mesopores. The extended defects and their complexes with vacancies as well as point defect - impurity associates are detectable and sensitivity of positrons to these shallow traps is enhanced by cryogenic temperature measurements. Positrons quantify defect microstructure characteristics as density, type, and local atomic chemistry. PAS has proven to be highly effective in characterizing vacancy-hydrogen complexes during low temperature baking * as well as for vacancy kinematics and evolution of point defects and native Nb oxides for baking at larger temperatures **.

In this contribution, defect microstructure of DC magnetron sputtered Nb and Nb3Sn thin films will be discussed, supplemented with conventional characterization methods such as XRD and vibrating sample magnetometry (VSM). The combination of these complementary techniques will provide correlations between sputter deposition parameters, e.g., deposition pressure, gas flows, etc., defects, crystal phases, and superconducting characteristics (Tc, Hc). Our long-term goal is to enable in-situ PAS during sample processing to study defect formation and their evolution.

I have read and accept the Privacy Policy Statement

Yes

Footnotes

*M. Wenskat et al., Sci. Rep. 10 (2020) 8300.**M. Wenskat et al., Phys. Rev. B. 106 (2022) 094516.

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