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Oxygen Vacancies in High-Tc Superconductor Studied with a Scanning Positron Beam

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In solid state physics and materials science the positron is applied as a highly mobile nano-probe for the detection of vacancy-like defects and their chemical surrounding using (coincident) Doppler broadening spectroscopy ((C)DBS) of the positron-electron annihila-tion line. A scanning positron beam allows depth dependant defect spectroscopy and the imaging of defect distributions.

The neutron induced positron source NEPOMUC at FRM II provides the world's highest intensity of 10^9 moderated positrons per second. Within this contribution we present spatial resolved (C)DBS experiments on thin film samples of the high-Tc superconductor$YBa_2Cu_3O_{7-\delta}$ (YBCO). First, the positron beam was applied to image the oxygen deficiency. By combining transport measurements, X-ray diffraction and CDBS we succeeded in correlating the relevant parameters Tc, expansion of the c-axis, oxygen deficiency δ, and the S-parameter obtained by DBS [1]. Afterwards, the positron implantation energy was varied in order to reveal the depth dependent transition temperature in tempered thin film YBCO samples [2].

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