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The Coincidence Doppler-Broadening Spectrometer at NEPOMUC

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Doppler-broadening spectroscopy (DBS) of the 511keV gamma line generated by positron-electron annihilation provides information on lattice defects. It is sensitive to concentrations as low as 1e-7 vacancies per atom. In addition, the chemical surroundings of defects can be analyzed by coincidence DBS (CDBS). The current status and recent improvements of the CDB-Spectrometer at the Neutron-induced Positron Source Munich (NEPOMUC) is presented.
The maximum probing depth of the positron beam is material dependent and varies from hundreds of nm, for heavy metals to a few micrometers in, e.g., Si. Two beam modes are available: standard measurements with a $\approx$ 300 μm (FWHM) beam spot and high resolution measurements with a micro beam with a spatial resolution of 33 μm (FWHM). Measurements may either be conducted as DBS, where the signal at each detector is treated separately, or as CDBS, where the detectors are run as coincidence pairs, greatly improving the signal-to-noise ratio. Currently, three different sample holders are available: i) a piezo x-y stage for precision 2D scanning and hence 3D defect imaging, ii) a heatable sample holder with $T_{max} = 1100$ K for temperature dependent defect spectroscopy, iii) a cryostat with $T_{min} = 40$ K.
The improvements comprise an automated beam optimization system and the increase in the number of detectors combined with an upgrade of the readout electronics.

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