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Spatially Resolved and Element-Sensitive Defect Analysis with Positrons

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The Coincidence Doppler Broadening (CDB) spectrometer with its monoenergetic scanning positron beam allows the investigation of defect distributions in three dimensions (3D) and the elemental surrounding of open-volume defects. With our instrument we address the following scientific questions:

- Homogeneity of samples, i.e. depth and lateral distribution of lattice defects. Examples are (laser beam or friction stir) welded technical alloys, irradiated materials, superconducting and (doped) thin semiconducting films.
- Defect kinetics and fast defect annealing at high temperatures, e.g. of samples after severe plastic deformation or plasma-facing materials for fusion reactors
- Vacancy-solute complexes and nano-clusters in, e.g. doped semiconductors or precipitation-hardened alloys
- In-operando defect analysis of samples, which are not stable in vacuum, exposed to gases and/or during application of electric fields. Examples are electrode materials or aging of thin polymer films in various atmospheres
- Fundamental research with otho-Positronium (o-Ps).

In order to cope with the forefront research questions we plan to upgrade the CDB spectrometer by considerably enhancing its performance in terms of (i) spatial resolution, (ii) measurement time and signal-to-noise, and (iii) high sample temperature. The upgrade project comprises the (i) implementation of a novel two-fold positron remoderation stage, (ii) optimum coverage of the field-of-view by extension of the detection system, and (iii) installation of an infrared laser for contact-less sample heating.

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