MM 40: HV Haaks

Time: Friday 10:15–10:45

Location: H16

Invited Talk   MM 40.1   Fri 10:15   H16
Material science with positrons: From Doppler-Spectroscopy to Failure Prediction — ●MATZ HAAKS — Helmholtz-Institut für Strahlen und Kernphysik, Nußallee 14-16, 53115 Bonn

Failure of construction parts due to fatigue is a phenomenon well known in everydays life. Since almost 150 years the lifetime of construction parts is determined employing destructive test series like the Wöhler-test, where a huge number of identical samples has to be tested in a very time-consuming way. Up to the present these methods have not changed in principle.

On a microscopic scale material fatigue is based on accumulation of dislocations and other defects in the lattice. Already in the early stages of fatigue - within the first couple of load cycles - a significant increase of the defect density can be observed non-destructively by Positron Annihilation Spectroscopy (PAS) with an extreme sensitivity. Scanning Positron Microscopy (SPM) expands the capabilities of PAS into the micron range. With SPM - employing an annihilation line shape parameter quantifying the Doppler shift due to the electrons momentum (S-parameter) - the density of defects (vacancies, dislocation jogs, vacancy-clusters) in the subsurface layer can be visualised.

Since the density of defects rises during fatigue, it can be employed as a precursor for the final state of failure. Assuming that failure occurs when a critical defect density is reached locally, failure can be predicted from measurements supported by garnular model calculations in the very beginning of fatigue tests.