MM 43 Diffusion III

Time: Friday 12:30–13:30 Room: IFW B

MM 43.1 Fri 12:30 IFW B

Imaging of defect structure in fatigued carbon steel C45E — •Patrick Eich, Matz Haaks, and Karl Maier — Helmholtz Institut für Strahlen- und Kernphysik, Rheinische Friedrich-Wilhelms-Universität Bonn, Nußallee 14-16,D-53115 Bonn, Germany

Nowadays all used construction parts have a finite lifetime under alternate conditions. Hence, a precise damage prediction would be very useful. The observation of the microscopic process of fatigue in a metal is a condition for a reliable damage prediction. Physically, the reason for fatigue is the accumulation of lattice defects, like dislocations, vacancies and vacancy clusters. The increase of the defect concentration due to alternate load fatigue can be observed by positron annihilation spectroscopy. The deformation state at higher load cycle numbers can be estimated from the defect concentration in the early stages of fatigue. [1] Even if a homogeneous stress field is applied, heterogeneous structures in the defect concentration are formed during fatigue. These structures can be imaged using the fine focus positron beam of the Bonn Positron Microprobe. Samples of the carbon steel C45E were tested with alternate load fatigue. At different stages the defect density was examined with a spatial resolution in the micrometer range. [1] M. Haaks, K. Maier in V. Jentsch et al. *extreme events*, Springer 2005, in press

MM 43.2 Fri 12:45 IFW B

The effect of low stresses on creep and surface profiles of thin copper wires — •Vivek Srivastava[1], Howard Jones[2], and Geoffery Greenwood[2] — [1]Otto-von-Guericke-University Magdeburg, Institute of Materials Engineering & Testing, PO Box 4120, D-39016 Magdeburg, Germany — [2]Department of Engineering Materials, University of Sheffield, Mappin Street, Sheffield S1 3JD, UK

At low stresses and high temperatures, materials creep by stress directed diffusion of vacancies, i.e. diffusional creep. The creep rates and surface profile changes of wires, of diameters from 25*500 microns of high purity (99.995%) copper, have been investigated close to their melting temperature under stresses up to 0.4 MPa. Strain rate always varied linearly with stress. For the thinnest wires the rate was about twice the rate expected from Nabarro*Herring creep and more than one order of magnitude larger than expected from Harper*Dorn creep. For 500 microns wires, the measured rate was initially close to Harper*Dorn prediction but became constant only after longer durations at a level five times lower than this. The wire profiles near the closely perpendicular boundaries showed a smooth diameter increase or decrease depending on whether the stress was sufficient or insufficient to overcome the effect of the surface tension forces tending to shrink the wire. These profile changes indicated the location of vacancy sources and sinks and the measured steady state creep rates could be accounted for by the direction and magnitude of the vacancy fluxes.

MM 43.3 Fri 13:00 IFW B

Radiation damage in fused quartz — •Poornnima Anbalagan[1], Christine Negrini[1], Andre Engelbertz[1], Bernd Habenstein[2], and Karl Maier[1] — [1]Helmholtz - Institut für Strahlen- und Kernphysik, Nußallee 14-16, 53115 Bonn — [2]General Electric, Köln

Radiation damage has always been a topic of great interest in various fields of sciences. We have made an attempt to probe into the effect of subthreshold ultrasonic waves on the radiation damage created by irradiation of protons and alpha particles in the model system fused quartz. Three independent techniques were used to visualize the radiation damage. The polarization microscope shows the so-called Bragg-Peak, which is the region of maximum damage indicating internal stress in the sample. Positron annihilation spectroscopy was used to analyze the suppressed positronium generation due to the reduced positron diffusion as a result of radiation damage. UV-absorption spectroscopy shows a dominant absorption peak at an optical wavelength of 210nm. This corresponds to the E'-Centers and is an observable electronic defect. Surprisingly, the Bragg-Peak (which is identical with the particle range) is observable with the polarization microscope but not in the case of UV-absorption spectroscopy. A comparison between the samples that were irradiated and the samples that were exposed to ultrasonic waves simultaneously with irradiation shows the influence of the standing ultrasonic wave.

MM 43.4 Fri 13:15 IFW B

Surface nano-structural modifications in Mo by nitrogen ion implantation as a function of temperature — •Hadi Savaloni[1,2], Mariam Motmaen Dadgar[2], Mahmood Ghorannevis[2], and Mohamad-Reza Hantehzadeh[2] — [1]Dept. Of Physics, University of Tehran, North-Kargar Street, Tehran, Iran — [2]Plasma Physics Research Center, Science and Research Campus of I. A. University, P. O. Box 14665-678, Tehran, Iran.

The structural characteristics of nitrogen ion implanted MO massive samples (0.5 mm foils) are studied by SEM, XRD, AFM, and SIMS. 20 KeV nitrogen ions with a dose of $1 \times 10^{18} N^{+} cm^{-2}$ were implanted in Mo samples at different temperatures. XRD patterns clearly showed MoN(031) line very close to Mo(200). AFM images showed the formation of grains on Mo samples, which grew in size with temperature. The surface roughness variation with temperature, decreased to a minimum, and further increase in temperature increased the surface roughness. SIMS analysis of the density of implanted N+ ions, and the depth of N+ ion implantation in Mo, showed a minimum for both the N+ density and depth of N+ ions, at a certain temperature consistent with XRD results (i.e., IMo(200) /IMo(211) and IMoN(031) /IMo(200)). These observed minimums in XRD and SIMS results are again similar to those obtained for N+ ion implanted W (Savaloni et al., 2005) and for XRD results in different thin films(Physica B, 349(2004)44; Vacuum, 77(2005)245).