Crack Formation and Fracture of Steels in the 300 - 3000 N / mm^2 Range under Cyclic Loading with 20 kHz

R. Mitsche, Institut f. Metallkunde und Werkstoffprüfung
Montanistische Hochschule Leoben
St. Stanzl, II. Physikalisches Institut, Universität Wien

In spite of a lot of research work done in the field of cracking and fracturing of b.c.c. metals and alloys under static and cyclic stresses, several problems are still open to further investigation. This refers especially to the behaviour of iron-base materials e.g. steels, cast iron a.s.o. under ultrasonic stress.

In previous papers we have reported some results on the behaviour of steels in the range from 300 - 3000 N/mm^2 under 20 kHz (especially soft steels) produced by different metallurgical methods. All ultrasonic experiments have been carried out by a resonance method with sample of half wave length (see report Nr. 123 Weiss-Kromp-Maurer).

Our researches covered fundamental and pilot experiments rendering the

1) Influence of ultrasonic preloading with different alternating stresses in the temperature range 20 - 300°C. On

1.1) surface phenomena, on the formation of dislocation structures and their mutual relations

1.2) Changes in the behaviour under static stress

1.3) Formation of cracks and fracture. Fracture structures observed under the scanning microscope.

1.4) The influence of sample size, shape and surface conditions.

1.5) Size and distribution of the areas in the sample strained to an extent rendering recrystallisation by subsequent heating.

2) The short-time determination of S-N (stress versus number of cycles)-curves (Wöhler-curves) using 20 kHz

2.1) Comparison of fatigue limits under low (100 - 200 Hz) and high cycles (20 kHz)

2.2) Influence of temperature

2.2.1) Selfheating of samples by damping

2.2.2) Necessity and possibilities of controlling sample temperature by different cooling and heating mediums.

From our results it had became obvious that still much more research work in this field is badly needed.

Some of the main problems are:

a) The influence of the ambient medium

b) Extension of the experiments at lower as well as to higher temperatures

c) comparison of crack and fractures under static and dynamic, especially ultrasonic stresses with the scanning microscope.

d) Checking crack formation and propagation by the aid of high frequency cinematography.

In those mentioned respects we have done research work in the meantime and results will be given in our lecture.