High resolution in-situ fatigue damage analysis and extrusion kinetics with ROCS microscopy

INTRODUCTION

For an optimized prediction of the material’s lifetime behaviour, two existing setups were combined. The objective was to gain a better knowledge and understanding of the microstructure sensitive damage mechanisms and extrusion kinetics during very high cycle fatigue (VHCF). Current simulation prediction strategies including discrete dislocation dynamics (DDD) and crystal plasticity finite element method (CPFEM) require experimental observations of fatigue processes to validate their underlying models. The multiaxial setup for damage detection [1] was complemented with the rotating coherent scattering (ROCS) microscopy [2] for high resolution in-situ observation under normal air conditions.

METHODS

The multiaxial setup for damage detection in the VHCF regime by Straub et al. [1] is illustrated in Figure 1. In the further miniaturized in-situ ROCS-fatigue setup only one piezo-actuator is used, so fatigue under bending vibrations can be investigated. With a laser and a position sensitive detector the displacement of the sample is controlled over the piezo signal. Experiments run typically with sample resonant frequencies around 2 kHz, so that 10^9 cycles can be reached in a convenient time.

RESULTS

The different damaging stages can be tracked by the relative frequency change over the number of cycles showing different decreases during damage and crack initiation.

The resolution in-situ observation under normal air conditions.

REFERENCES
