INTERDISCIPLINARY CENTRE FOR
ADVANCED MATERIALS SIMULATION

Special Seminar

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⇒ **Seminar room IA 1/21** ⇐

Cyclic slip irreversibilities and the evolution of fatigue damage

In this survey, the physical origin of fatigue crack initiation in ductile metals is discussed from a historical perspective. The main focus is to assess those cyclic slip irreversibilities in a microstructural sense that occur not only at the surface but also in the bulk at the dislocation scale and to show how they contribute to surface fatigue damage. The evolution of early fatigue damage, as evidenced experimentally in the last decades, is reviewed. The phenomenon of cyclic strain localization in persistent slip bands and models of the formation of extrusions, intrusions and microcracks are discussed in detail. The predictions of these models are compared with experimental evidence obtained on mono- and polycrystalline face-centred cubic (fcc) metals. In addition, examples of the evolution of fatigue damage in selected fcc solid solution alloys and precipitation-hardened alloys and in body-centred cubic (bcc) metals are analyzed. Where possible, the cyclic slip irreversibilities p, defined as the fraction of plastic shear strain that is microstructurally irreversible, have been estimated quantitatively. Broadly speaking, p has been found to vary over orders of magnitude ($0 < p < 1$), being almost negligible at low loading amplitudes (high fatigue lives) and substantial at larger loading amplitudes (low fatigue lives).