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Abstract Book

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The relationship between the shear banding evolution and the stress-strain responses under bending and compression were carefully observed. And the intrinsic correlation between the shear banding behaviors and the ductility/brittleness of MGs was further revealed. At last, based on the experimental data and mechanical analysis, an energy model on shear band propagation was proposed.

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S12-006

A new damage identification strategy for SHM based on FBGs and Bayesian model updating method

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One of the difficulties of the vibration-based damage identification methods is the nonuniqueness of the results of damage identification. The different damage locations and severity may cause the identical response signal, which is even more severe for detection of the multiple damage. This paper proposes a new strategy for damage detection to avoid this nonuniqueness. This strategy firstly determines the approximates damage area based on the statistical pattern recognition method using the dynamic strain signal measured by the distributed fiber Bragg grating, and then accurately evaluates the damage information based on the Bayesian model updating method using the experimental modal data. The stochastic simulation method is then used to compute the high-dimensional integral in the Bayesian problem. Finally, an experiment of the plate structure, simulating one part of mechanical structure, is used to verify the effectiveness of this approach.

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S12-007

Rolling contact fatigue damage of bearing steel with surface defect

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Rolling contact fatigue (RCF) failure initiated from surface damage is a typical failure mode of bearing systems. Understanding the mechanisms of rolling contact fatigue of bearing steel with surface defect is of great interest for evaluating the performance, life expectancy and reliability of bearing and engine systems. In this paper, the rolling contact fatigue damage of bearing steels with surface defects is numerically investigated. Four aspects are taken into account: (1) the effect of surface defect on bearing steel, (2) the effect of shear term on the change of the void volume fraction, (3) the effect of loading, and (4) the effect of yield stress. The numerical results show that hydrostatic pressure is dominated in the contact area, and shear effect reach maximum at the dent shoulder and around, while shear has an important effect on the damage evolution in rolling contact.

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S12-008

Criticality of damage-failure transitions under dynamic and fatigue loading

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Statistical theory of evolution of typical mesoscopic defects (microcracks, microshears) revealed specific type of criticality-structural-scaling transitions and allowed the development of phenomenology of damage-failure transition (Naimark 2003, 2004) based on the definition of non-equilibrium free energy of solid with defects. The key results of statistically based phenomenology are the establishment of characteristic multiscale collective modes of defects responsible for plastic strain localization and damage-failure transition. These modes have the self-similar nature of the solitary wave and blow-up dissipative structure, and provide the multiscale mechanisms of plastic relaxation and damage-failure transition. High resolution experiments and structural (SWFM and AFM) study in terms of scaling invariance supported the linkage of the evolution of these modes with material responses in large range of load intensity (dynamic crack propagation, fragmentation statistics, crack path under high cycle (HCF) and very high cycle (VHCF) fatigue) and allowed us to propose the interpretation of the following effects: 1) Nonlinear crack dynamics and the transition from the steady-state to the branching regime of crack propagation. The existence of two critical velocities, three characteristic regimes of crack dynamics as the precursors of fragmentation; (2) Fragmentation dynamics and qualitative changes of fragmentation statistics depending on the energy imparted into the specimen and related to the multiscale interaction of blow-up damage localization modes; (3) The link of defect induced scaling and scaling laws of fatigue crack path under HCF and VHCF, qualitative changes in the scenario of damage-failure transition near fatigue threshold and VHCF of fine grain materials.

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S12-009

Modeling of effective elastic constants and fracture toughness in metal-ceramic composites with interpenetrating microstructure

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The paper is focused on modeling of the overall elastic properties and crack toughening mechanism by bridging in metal-ceramic interpenetrating phase composites (IPC). The Tuchinskii-Feng analytical model (Feng 2004) especially devised for IPC microstructures is further developed. Numerical FEM models of the effective elastic constants are implemented for the simplified 3-D cross microstructure and real microstructures based on micro-CT scans. The energy release rate increase due to crack bridging (Mataga 1989) is modeled numerically. The stress-displacement relationships in the reinforcing fibers undergoing large strains and delamination from the matrix materials are obtained and then applied as material models for the bridging reinforcements in compact-tension test specimen of the fracture toughness determination. The J integral for this specimen is calculated by FEM (Abaqus) with reinforcing ligaments modeled as truss and cohesive elements. The growth of a bridged crack is also modeled numerically.

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S12-010

Life prediction model based on the growth of TGO and infiltration of CMAS for themal barrier coating systems

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This article focus on the coupled effect of thermally grown oxide and glassy melts mainly consisting of calcium-magesium alumino-silicates (CMAS) on the liftime of thermal barrier coating systems (TBCs). The glass wets all coating materials of interest can penetrate the TBC void spaces that accommodate the strain incompatibility with the metallic substrate. A generalized fatigue life model for thermal shock conditions of Basquin type is proposed, with the model combined with FEM method obtaining an approximate life prediction of TBCs.

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S12-012

Dynamic fracture of metals in wide range of strain rates

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A model of dynamic fracture in tensile stresses at very high strain rates ($> 10^6 s^{-1}$) is presented. It uses two-level approach for fracture description. Micro-level of modeling deals with individual micro-cracks in crystalline material and describes their thermo-fluctuation nucleation,