

Editorial

Fracture Behavior of Innovative Materials under Different Environmental Conditions

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1. Introduction and Scope

The interest in the fracture assessment of steel and other alloys at high temperatures and under aggressive environments has increased continuously in the last few years. However, the fracture of structural components under these conditions has not been deeply investigated, either experimentally or theoretically. The applications in which the fracture phenomenon is affected by high temperatures and aggressive corrosive environments [1–5] are of considerable interest and involve different industrial sectors, such as transportation, energy, and metal manufacturing (e.g., jet engine components, nuclear power plants, pressure vessels, hot rolling of metal). To provide as optimum a performance as possible in these highly demanding conditions, it is necessary to be aware of the requirements of each application and of the proper tools to perform fracture and fatigue assessments under aggressive conditions. The present Special Issue aims at presenting an updated state of the art related to these problems, providing to the readers an overview of the current open issues and their possible solutions.

2. Contributions

Seven articles have been published in the present Special Issue of *Metals* encompassing the fields of fatigue damage, high-cycle fatigue, fatigue and creep interaction, and fatigue in aggressive corrosive media. As it is clear from the published papers, this is a multidisciplinary area including materials science, structural analysis, manufacturing technologies, quality control and evaluation, mathematics, physics, and probability and reliability. Interdisciplinary works are presented herein aimed at understanding and deploying the physics of fatigue and failure techniques, advancing experimental and theoretical failure analysis, and modelling the structural response with respect to both local and global failures and the structural design that accounts for scale and time effects for the prevention of engineering failures in the presence of aggressive service environments. An aggressive environment can be extremely detrimental for the fatigue life of a structure working in an aggressive environment, and protection against corrosion is necessary to maintain adequate fatigue properties and warrant the safety of the structure's components. Designers must consider corrosion for a proper design against fatigue loadings. Corrosion is also undesirable for reasons related to the safe and economic use of a structure during its service life. Some recent advances on the topic are well presented in a study [6] providing a useful and updated overview of the problem connected with the fatigue damage of magnesium alloys. The impact fracture behavior of the 14%Cr Oxide Dispersion Strengthened (ODS) steel (ODM401) after high temperature exposures in helium and air in comparison to the as-received state is investigated in another work [7]. Another relevant field of applications is related to biocompatible materials. The effect of ultrasonic nanocrystal surface modification (UNSM) on the fatigue behavior of Ti6Al4V (TC4) in a simulated body fluid (SBF) was investigated in a study [8]. Titanium alloys, in view of their high strength-to-weight ratio and excellent corrosion resistance, have been widely used in biomedical implants. Implants that function as bones, such as artificial joint

endoprostheses, hip joints, bone plates, and tooth roots, are used under severe oscillating loading conditions, and some of them are usually subjected to long-term cyclic loading. As it is clear from the selected papers taken from the Special Issue, the variety of topics and applications is wide, and the interest and potential impact on the society are very high. This Special Issue has the ambition to point out the open problems in the field, giving an updated overview on some interesting topics.

3. Conclusions and Outlook

A variety of connected topics has been compiled in the present Special Issue of *Metals* providing a wide overview of recent developments in different aspects of fracture and fatigue damage in aggressive environments. Hopefully, this Special Issue will be the starting point for future discussions and scientific debate on challenging topics related to fracture and fatigue of structural components working in severe conditions. The topic, in fact, remains very actual and with high and relevant impact in many applications. The selected papers touch different important topics of fatigue and fracture of structural materials. Scale effects and multiscaling approaches are a fundamental part of these topics that allow a better understanding of the fatigue damage at different scale levels.

As guest editor of this Special Issue, I am very happy of the final result and hope that the present papers will be useful to researchers and designers working on the demanding objective of failure prevention in the presence of cyclic loadings. I would like to warmly thank all the authors for their contributions and all the reviewers for their efforts to ensure high-quality publications. At the same time, I would like to thank the many anonymous reviewers who assisted me in the reviewing process. Sincere thanks also to the Editors of *Metals* for their continuous help, and to the *Metals* Editorial Assistants for their valuable and inexhaustible engagement and support during the preparation of this volume. In particular, my sincere thanks to Natalie Sun for her help and support.

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