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Editorial

Fatigue and Fracture of Traditional and Advanced Structural Alloys

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Prevention and prediction of unexpected fracture and fatigue failures constitute a key objective in any engineering application. Nevertheless, the increase in complexity in modern structures and components makes this key objective very challenging and sometimes only partially reachable. Catastrophic failures often involve the loss of human lives. Within the last few years, a drastic improvement has been achieved in many of the necessary tools and methods to either avoid or mitigate the consequences of failure. This recent development is strongly associated with the ever-increasing performance of traditional and innovative structural alloys as well as with the capacity of controlling process parameters during the realization and manufacturing of the final structure. There is still an impressive room for improvement in this field. This requires a multidisciplinary pool including materials science, structural analysis, manufacturing technologies, quality control and evaluation, mathematics, physics, and probability and reliability. Furthermore, from a scientific point of view, it is also fundamental to increase our knowledge of concepts and approaches that can account for size and time-scaling effects. The Special Issue scope embraces interdisciplinary work aimed at understanding and deploying physics of fatigue and failure techniques of traditional and advanced structural alloys, advancing experimental and theoretical failure analysis, modelling of the structural response with respect to both local and global failures, and structural design that accounts for scale and time effects in preventing engineering failures. This state of the art will help engineers, designers and people from the academy to have an updated state of the art on this very challenging topic which is nowadays very important due to the advances in manufacturing technologies that allow complex new materials to be fabricated.

Thirteen articles have been published in the present Special Issue of *Metals* encompassing the fields of fracture and fatigue damage, high cycle fatigue, fatigue and creep interaction and fatigue in aggressive corrosive media. This grouping is not hard-bound, and thematic links can be established beyond them, which shall be emphasized in the following presentation.

High cycle fatigue is a traditional topic but still very challenging, as is well described in some of the present contributions. In particular, it becomes more and more critical if large scale effect occurs in the full-scale component also in civil construction and megastructures [1]. Aspects related to microstructure and interaction between fatigue properties and metallurgical properties are also very important for the fatigue design.

Interest in fatigue assessment of steels and different alloys under multiaxial loading has increased continuously in recent years. Likewise, the applications of multiaxial fatigue phenomenon of interest have increased substantially in recent years and our capacity to assess fatigue life under complex loading has substantially improved [2]. To provide as optimum a performance as possible in these high demanding conditions, it is necessary to be aware of the application and proper tools required to perform the fatigue assessment under complex loadings.

An aggressive environment due to corrosion and temperature can be extremely critical for the fatigue life of a structure in their service conditions [3]. Designers must consider corrosion in service

and high temperature for a proper design against fatigue loadings. Corrosion is also undesirable for reasons related to a safe and economic use of a structure during its service life. Some recent advances of the topic are present in [3] providing a useful and update overview of the problem connected with the fatigue damage of structural materials.

A variety of connected topics have been discussed in the present Special Issue of *Metals*, providing a wide overview of recent developments on different aspects of fracture and fatigue tools available for fracture and fatigue assessment of traditional and innovative materials. Hopefully this Special Issue will be the starting point for future discussions and scientific debate on challenging topics related to fracture and fatigue design. This topic, in fact, remains very actual and has a high and relevant impact for many applications. The selected papers touch different and important topics for fatigue and fracture of structural materials. Scale effect 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 satisfied with 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 present cyclic loadings. I would like to warmly thank all the authors for their contributions and all 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 valuable and inexhaustible engagement and support during the preparation of this volume. In particular, my sincere thanks to Toliver Guo for his help and support.

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