metals

MDPI

*Editorial*

# Failure Analysis in Metallic Materials

**Riccardo Nobile**

Department of Engineering for Innovation, Università del Salento, 73100 Lecce, Italy; riccardo.nobile@unisalento.it; Tel.: +39-832-297-771

## 1. Introduction and Scope

Failure analysis is a complex task that plays a fundamental role in technical applications. The high variety of phenomena that could result in engineering failure, the difficulties in understanding the material behavior, and the geometrical complexity of the components, make it extremely difficult to individuate the cause and the chain of events before failure, especially when exceptional loading conditions are applied. However, the knowledge of the various theories of failure, combined with the specific behavior of materials, the correct combination of structural, thermal, and environmental loads, observation of the fracture surface, and finally an analyst's experience in the field allow the problem to be analyzed from a scientific point of view.

Because of these considerations, a collection of failure case studies in the technical literature and a description of how the different failure analyses were carried out is essential for the development of the specialists involved in failure analysis.

This Special Issue aims to contribute to improving the technical knowledge in this field, and collects several articles studying all the aspects that contribute to the determination of the failure of metallic materials.

## 2. Contributions

Five manuscripts were accepted for publication after a rigorous peer-review process.

Cicero and Arrieta [1] described a methodology to evaluate the fracture toughness of ferritic steels based on the master curve approach. The novelty of the paper is the extension of the approach to notch geometries, which is a common condition in practical applications.

Štefan et al. [2] studied the microstructure and the fracture toughness of austenitic laser-cladded layers on the inner surface of a nuclear reactor pressure vessel. In this case, the importance of the application required a deep comprehension of the failure mechanics, starting from a microstructural scale.

The prediction of fracture criteria of a high-strength steel plate subjected to ballistic impact is the subject of the manuscript submitted by Shi et al. [3]. Thanks to the experimental ballistic tests, authors proposed a numerical model, showing the role of the Lode parameter for the correct prediction of the ballistic resistance.

A complete characterization of the rolling contact fatigue process in the railway industry is reported in the work by Seo et al. [4]. In particular, authors used a high variety of experimental techniques, comprising wear and fatigue tests, fracture mechanics tests, hardness and residual-stress measurements, and microstructural analysis to describe the damage of the material both for the wheel and rail.

Finally, Luo et al. [5] described the leakage from oil-pipe cracking. In this case, the authors reported that the crack started from the external surface of the pipe in pattern with a weld-fusion line. The cause of the crack was found in the inclusions observed in the weld zone, showing the importance of the welding process quality. Based on this evidence, the authors proposed an assessment procedure for the correct utilization of the pipeline.

This quick review of the manuscripts collected in this Special Issue gives an indication of the high variety of problems and situations that can occur which may lead to a failure analysis being requested.



**Citation:** Nobile, R. Failure Analysis in Metallic Materials. *Metals* **2023**, *13*, 1374. https://doi.org/10.3390/met13081374

Received: 12 July 2023
Accepted: 14 July 2023
Published: 31 July 2023

## 3. Conclusions and Outlook

The failure analysis of metallic materials is a problem far from being solved, as new materials, new manufacturing processes, new loading conditions, and new component designs are continuously introduced in industrial applications. However, this Special Issue makes some contributions to enhancing the comprehension of those metallic failures, at least with specific cases that have been reported. The personal hope of the guest editor is that the readers may find the data, the observations, and the methodology presented in these papers useful.

Finally, the guest editor is grateful to all members of the editorial board and to the editorial office of *Metals* for the opportunity to publish this Special Issue. However, the main thanks must be reserved for all the authors that decided to contribute to the success of this Special Issue, and to all the reviewers who contribute with their work behind the scenes to improve the quality of the manuscripts.

**Conflicts of Interest:** The author declares no conflict of interest.

## References

1. Cicero, S.; Arrieta, S. Dealing with the Fracture Ductile-to-Brittle Transition Zone of Ferritic Steels Containing Notches: On the Applicability of the Master Curve. *Metals* **2021**, *11*, 691. [CrossRef]
2. Štefan, J.; Siegl, J.; Adámek, J.; Kopřiva, R.; Falcník, M. Microstructure and Failure Processes of Reactor Pressure Vessel Austenitic Cladding. *Metals* **2021**, *11*, 1676. [CrossRef]
3. Shi, Y.; Hu, A.; Du, T.; Xiao, X.; Jia, B. Experimental and Numerical Study on the Protective Behavior of Weldox 900 E Steel Plates Impacted by Blunt-Nosed Projectiles. *Metals* **2022**, *12*, 141. [CrossRef]
4. Seo, J.; Hur, H.; Kwon, S. Effect of Mechanical Properties of Rail and Wheel on Wear and Rolling Contact Fatigue. *Metals* **2022**, *12*, 630. [CrossRef]
5. Luo, J.; Li, L.; Zhu, L.; Zhang, L.; Wu, G.; Zhao, X. Oil-Pipe Cracking and Fitness-for-Service Assessment. *Metals* **2022**, *12*, 1236. [CrossRef]