



Materials Performance & Characterization

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The journal publishes high-quality, original articles, including full papers, review papers, and technical notes, on both theoretical and practical aspects of the processing, structure, properties, and performance of materials used in mechanical, transportation, aerospace, energy systems, and medical devices. These materials include metals and alloys, glass and ceramics, polymers, composite materials, textiles, and nanomaterials. The journal covers topics related to the integrity of materials which encompasses mechanical testing, fatigue and fracture, corrosion, wear, and erosion, as well as the integrity of components and systems such as rolling element bearings, piping and pressure vessels, fasteners, space technology, and nanotechnology. The journal publishes articles on both qualitative and quantitative methods used to characterize materials including all forms of microscopy, chemical analysis, and nondestructive evaluation.

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Overview

Special Issue on Residual Stresses

In the field of industrial engineering, a well known fundamental principle is that manufacturing-induced residual stress states have a considerable influence on reliability, strength, and lifetime of components. There is a great and still increasing demand to include existing residual stress distributions into design rules. Consequently, for the full exploitation of the potential of highly and complexly loaded components, e.g. for light weight constructions, the exact and reliable determination of existing residual stress distributions is crucial. The availability of fast, reliable, and economic methods for residual stress analysis, therefore, is a key factor for the successful manufacturing of advanced materials and structures and for the reduction of production costs. The correct consideration of residual stress states already in the design phase of components based on modeling and simulation techniques is an important step towards short production cycles, to increase the degree of safety and reliability of relevant parts as well as for the economical use of materials.

A variety of destructive or nondestructive types of methods for the analysis of residual stress states have been developed in the past, based on the physical consequences of residual stresses in materials and components. The situation is characterized by a partially complex scientific basis as well as by manifold and different requirements of the industrial users. The intensive cooperation between researchers in the field of residual stress analysis and industrial users of the methods—as well as manufacturers of devices for residual stress measurement—over the years has led to significant progress in this interdisciplinary field. Typical methods that are today well accepted and widely used for industrial applications are diffraction techniques (X-ray diffraction, neutron diffraction), mechanical methods (sectioning techniques, hole drilling, contour method, etc.), but also ultrasonic techniques as well as magnetic methods that have been developed and applied with increasing success. For diffraction techniques as well as for the hole drilling method, standards of good measurement practice have been determined. They describe the proper application of measurement techniques and possible errors, however, only for relatively simple standard cases. Experimental procedures are more and more complemented by theoretical methods, which allow for the simulation of the residual stress generating processes. Combinations of experimental and theoretical methods are increasingly gaining importance, especially during the design phase of components.

This special issue of *Materials Performance and Characterization* presents 33 papers on origins, determination, and assessment of residual stresses in technical components. The articles describe the latest advances in measurement techniques and applications for technical components. Metallic as well as polymeric and composite materials are considered. Welding and surface treatment processes and the associated formation of residual stress fields are important areas of application. Other aspects that are addressed are heat treatment and stress relief, additive manufacturing and forging.

Producing this special issue was only possible by the joint effort of authors, reviewers, editors, and the publication team. The guest editors are especially grateful for the support of Dr. Rick Neu and Dr. George Totten from ASTM and also for the effective and close cooperation with Ms. Alyssa Conaway as a responsible member of the publishing team.

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IN APPRECIATION

The high quality of the papers that appear in this publication is a tribute not only to the obvious efforts of the authors represented but to the unheralded, though essential, efforts of their reviewers. It is to the reviewers dedication to upholding the high standards of their profession that this note pays tribute. On behalf of ASTM International and the authors as well, we acknowledge with appreciation their important contribution to the success of this journal.



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