

Residual Stresses and Nanoindentation Testing of Films and Coatings

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 Science Press
Beijing

 Springer

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ISBN 978-981-10-7840-8 ISBN 978-981-10-7841-5 (eBook)
<https://doi.org/10.1007/978-981-10-7841-5>

Jointly published with Science Press, Beijing, China

The printed edition is not for sale in China Mainland. Customers from China Mainland please order the print book from: Science Press.

ISBN of the China Mainland edition: 978-7-03-056731-4

Library of Congress Control Number: 2017963295

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Printed on acid-free paper

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The registered company is Springer Nature Singapore Pte Ltd.

The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Preface

In the process of manufacturing and using of mechanical parts, the formation of residual stress cannot be avoided. Remanufacturing surface coatings and films will also produce residual stress. The residual stress has great effects on the fatigue strength, stress corrosion, and shape accuracy, etc. of parts, so how to accurately measure the residual stress, adjust the distribution, and reduce or eliminate the adverse effects of residual stress is of great scientific importance.

Since the causes of residual stress are extremely complex, people have not found mature and reliable theory and method to analyze and calculate the residual stress. The study on measurement and testing technology of the residual stress has been one of the hot issues in the engineering field. Although various measurement techniques and methods such as X-ray diffraction, curvature method, drilling method, Raman spectroscopy, magnetic method have achieved good results in different degrees, the measurement of residual stress in micro- and nanoscale has not yet made a breakthrough because of defects of the methods. The nanoindentation technique with the convenience, high accuracy, nondestructiveness, and other advantages has been widely used in measuring the mechanical properties of different kinds of materials. Therefore, to measure and evaluate the residual stresses by nanoindentation technique is bound to promote the development of all kinds of engineering technology and mechanical system and to provide a strong technical support for the development and improvement of nanoindentation techniques and methods for evaluating the performance and life of the parts.

This book focuses on the residual stress measurement of the surface coatings and films and comprehensively and deeply introduces the existing theoretical model of the nanoindentation methods. The scope and defects of different models are also summarized. The book is on the basis of the latest researches. The main contents and data mainly come from the publications of authors in recent years and as far as possible absorb the research essence of this field. The authors intend to introduce basic knowledge of nanoindentation technique for measuring the residual stress to readers, hoping that the experts and engineering technical personnel in areas of

manufacturing, mechanical design, and maintenance and remanufacturing can understand the characteristics and effect of this technique. The book contains a large number of references both at home and abroad. I would like to express my deep gratitude to the authors of the relevant documents.

Due to the limited level of the authors, some phenomena are still unclear. In addition, this book might have some inappropriate and erroneous points. For this reason, we would like to ask the criticism and notice of readers.

Thanks for the supports of Dr. Liu Jin-na and Dr. Li Hua-yi. This book would not be finished without their help.

Finally, we are grateful to the NSFC (51535011) and 973 Project (61328304) for their support to our research works.

Beijing, China

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About the Book

This book covers the basic principles and application of nanoindentation technology to determine residual stresses in films and coatings. It briefly introduces various detection technologies for measuring residual stresses, while mainly focusing on nanoindentation. Subsequently, nanoindentation is used to determine residual stresses in different types of films and coatings, and to describe them in detail.

This book is intended for specialists, engineers and graduate students in mechanical design, manufacturing, maintenance and remanufacturing, and as a guide to the practice of production with social and economic benefits.

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