

<<现代力学方法的技术转移与工 >

图书基本信息

书名：<<现代力学方法的技术转移与工程应用>>

13位ISBN编号：9787562825166

10位ISBN编号：7562825165

出版时间：2009-10

出版时间：华东理工大学出版社

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页数：606

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## 前言

This book is the seventh volume of the proceedings for the symposium series on Fracture Mechanics, an annual conference devoted to the exchange of information among the universities, research institutions and industry sectors in China and abroad. FM2009 is held in Chengdu, Sichuan Province, from October 16 to October 20, 2009. The first FM conference was held in 2003 at East China University of Science and Technology, Shanghai. Since then, the FM annual meetings have taken place at different cities in China. This includes FM2004 in Huangshan, Anhui Province, FM2005 in Zhengzhou, Henan Province, FM2006 in Nanjing, Jiangsu Province, FM2007 in Changsha, Hunan Province and FM2008 in Hangzhou, Zhejiang Province. These annual events are indicative of the fact that the FM symposium series has played an important role in promoting information exchange, inspiring new ideas, integrating practical and research findings and breaking new grounds for the young generation. As the globe is evolving into a more complex world, the structural integrity technology should adapt to the challenges of complexity of the environments and the machines themselves. An examination of the transferability and applicability of the current mechanics approaches or theories to practical applications should be imperative. As is known to us, any new model or approach must successfully transit two sequential "filters" between research initiation and application, i.e. a technical filter ( does it work ?

) and a technological filter ( does it make sense in the "real world" ?

). However, our mechanics research community is normally not sufficiently knowledgeable concerning the metrics of the technological filter and therefore "non ( application ) useful" research is conducted in many cases and in others the research is not carried far enough to allow practical applications. Aiming at bridging the gap between fundamental researches and applications, FM2009 brings together the mechanics research community and the application community to identify the transferability and applicability of current mechanics approaches for structural integrity assessment. The symposium ( FM2009 ) is co-organized by Southwest Jiaotong University, East China University of Science and Technology, National Engineering Research Center of Pressure Vessels and Pipelines Safety Technology ( General Machinery Research Institute ) , Nanjing University of Technology, Zhejiang University, Zhejiang University of Technology, Zhengzhou University, Changsha University of Science and Technology and Shandong University, and co-sponsored by the Chinese Consortium of Structural Integrity ( including members of Chinese Pressure Vessel Institution and the High Temperature Strength of Materials Committee of Chinese Materials Institution ) , Natural Science Foundation of China and General Administration of Quality Supervision, Inspection and Quarantine of China. On behalf of the organizing committee, we would like to thank the above co-organizers and co-sponsors who made FM2009 possible. We also appreciate the efforts of the steering committee members in reviewing and selecting the papers. We are grateful for Professor George C. Sih for his constant support to the symposium series. We are indebted to Professor Zhengdong Wang and Dr Chi Tsieh ( Jimmy ) Liu for their passion to the symposium and efforts made to ensure the success of the event. Special thanks are also due to the authors and speakers who make FM2009 unique.

## 内容概要

This book is the seventh volume of the proceedings for the symposium series on Fracture Mechanics, an annual conference devoted to the exchange of information among the universities, research institutions and industry sectors in China and abroad. FM2009 is held in Chengdu, Sichuan Province, from October 16 to October 20, 2009.

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## 章节摘录

插图：chemical kinetics process [4]. Nevertheless, the damage or deterioration process of material is not a simple elementary reaction. It is composed of highly complicated reactions of a series of different barriers. Hence, the activation energy during the deterioration process of materials is a function of temperature and time. This is different from the preconditions of the classical Arrhenius equation. Therefore, whether Arrhenius equation is applicable to describe the deterioration process of materials under different time scales needs further theoretical research and experimental validation [5]. There are similar bottleneck problems regarding the life prediction of deformation and fracture of materials under chemical attack, which require us to understand the synergetic effect of mechanics and chemistry [6]. Another emerging issue is in life prediction the time dependent fracture under complex stress state or constraint. The actual engineering structures or components are rather complicated. For example, there can be structural discontinuity, material discontinuity and load discontinuity required by service functions or introduced by manufacturing processes. The response to fracture of the structures can be very different from the behavior obtained from small specimens in the lab. On the other hand, in order to evaluate the service properties of actual structures, it is generally very difficult to remove a bulk material from the structure. Thus non-standard specimens are machined from the structures resulting in different constraints. Obviously the key would be to describe the actual failure process under constraints (under complicated stress status). In order to transfer the experimental results in labs to engineering components, lots of efforts have been taken to study the constraint effect on fracture at ambient temperature. It was recognized that the fracture toughness is no longer a constant unless the stress field near the crack tip is dominated by general fracture parameters (stress intensity factor  $K$  or  $J$ -integral) [7]. But in fact the structure thickness and crack dimension could hardly satisfy the constraint requirements near the crack tip and thus the fracture toughness tested from high-constraints samples in the lab cannot be directly used in engineering structures. Aiming at such shortcomings, a number of approaches including  $K$ - $T$  method applicable to linear elastic fracture,  $J$ - $Q$  theory under elastoplastic mechanism and three-parameter revision method, have been proposed [8]. Meanwhile, local approach based on Weibull stress and some other improved models have been proposed for the brittle fracture problems of thick components [9]. However, the time-dependent fracture under constraint effect is still a challenge issue. Much work should be done to quantify the time dependent constraint effect, develop the non-standard testing methods, and clarify the transferability of testing results. An emerging issue is to develop the micro- or miniature specimen testing method that can be used for the semi-destructive evaluation of service structures. At present, some research work has been done on obtaining the high-temperature creep properties by using non standard specimens. For example, indentation test can be used to measure the creep and fatigue properties of material (i.e. impression creep and compressive fatigue) in addition to general mechanical properties [10]. Small punch test has been well used in Europe and testing standard has been proposed [11]. A testing method based on ring specimen that uses the reference stress to correlate the experimental results with uniaxial ones has been proposed recently [12]. In fact, the specimens used for obtaining the material properties of service components can be very different (as shown in Fig. 1 !

) . Emphasis should be laid on the time-dependent deformation and fracture theory under constraint condition that enables the non-standard specimen test techniques [13].

4. Development trends in life monitoring From the view point of epistemology, there are no perfect design and perfect manufacture. To ensure the safe operation, life monitoring of critical industrial equipment should thus be imperative. At the same time, the applications of advanced materials and processing technologies in high tech products are now common practice though lack of testing data and service experiences. An on-line life monitoring system will help to identify the problems in the materials and processing, which in turn gives feedback to improve materials and design and manufacture besides securing the safe operation.

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