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Advanced heat engines can produce fuel efficiencies which greatly exceed those of today's gasoline and diesel engines, provided they operate at higher temperatures and vehicle weight is reduced. The main limiting factors are problems involving mechanical strength of materials at high temperatures. These problems can be solved, if a reliable mass-production of structural ceramics is achieved.

The book consists of two parts. In the first part state-of-the-art ceramics, such as silicon carbide and silicon nitride are studied for potential application to advanced heat engines. Microstructure, purity, secondary phases present and environmental effects are examined and correlated with thermal and mechanical properties, such as: Flexural strength, elastic modulus, stress dependence on strain, creep, oxidation resistance, thermal expansion, thermal diffusivity, thermal shock resistance and stress rupture. The use of zirconia in heat engines is also considered. At the end of the first part there is an Appendix with reflected light and scanning electron micrographs.

The second part is an economic evaluation which focuses on the economic impact of applications of structural ceramics, the need for federal research support and industry prospective. There are three Appendices on changes in the economic model, translations of Japanese newspaper articles and a synopsis of American counterattack. A short list of references appears at the end of the book.

The book is very comprehensive and covers the subject quite well. It is also well illustrated with the exception of some photomicrographs whose reproduction is rather poor.

BOOK NOTICE


Extensive research has been undertaken over the past twenty years in an attempt to enhance our understanding of the "Environmentally Assisted Cracking" phenomena. This category of material/environment effects include such cracking processes as stress corrosion cracking, corrosion fatigue, and hydrogen embrittlement. Most of the early research effort was spent in understanding the influence of various parameters (including pH, temperature, electrochemical potential, specific ions, microstructure, magnitude and state of stress, and strain rate) on the cracking process. The large number of variables, coupled with the interdisciplinary nature of the process (mechanics, metallurgy, electrochemistry, and surface sciences among others) has made it very difficult to synthesize the problem into a formulism that can be used to predict cracking quantitatively for any broad range of applications. Only in the last five years or so have even attempts been made to use our current understanding of the process in predicting material/component behavior exposed to aggressive environments.

The objective of the symposium was to compile a state-of-the-art of current modeling (empirical as well as physical) and experimental methods that enhance our capability in predicting environmentally assisted cracking. A total of twenty-six papers have been included in the proceedings with authors from the USA, Japan, Argentina, Canada, Italy, France, Finland, England, and the Netherlands. The proceedings are divided into four parts. The first part contains nine papers discussing stress corrosion cracking and corrosion fatigue prediction methodology. Most of the papers consider electrochemical and mechanics aspects of the process. Relatively little discussion is presented on the metallurgical issues of stress corrosion cracking and corrosion fatigue. Near crack tip strain rate is a major concern in the development of any model attempting to predict stress corrosion cracking or corrosion fatigue. Several papers in this group have attempted to address the issue. Some of the analyses are purely empirical while others are based on either elasti-plastic fracture mechanics or what is known as time based analysis. Although the time based analysis has not been thoroughly examined yet, it does seem to provide a relatively easy procedure for predicting crack growth rates. The second part of the proceedings contains four papers discussing crack tip modeling and measurement. Three of these papers discuss electrochemical aspects of the crack tip chemistry while the fourth paper discusses surface stresses near a crack tip. Such efforts to address the uncertainties involved in defining and measuring the near-crack-tip electrochemical and mechanical conditions can help to overcome one of the major stumbling blocks to developing a predictive methodology. The third part of the proceedings contain six papers on hydrogen effects. These papers cover atomistic simulation of hydrogen-enhanced fracture, diffusional aspects of hydrogen, test methodology, and metallurgical aspects of hydrogen embrittlement. The fourth part contains seven papers on test methods and analysis of data. The use of an intermediate-strain-rate test technique and small-amplitude cyclic loading to study stress corrosion cracking is discussed in this section. Other papers discuss stress-corrosion cracking of stainless steel piping and OFHC copper, fatigue-crack initiation of an aluminum alloy, and fatigue crack-growth correlations for stainless steel.