Introduction

The symposium was organized to document the current state of the art in fatigue and facture toughness of aluminium, steel, and titanium alloys at room and cryogenic temperatures. Included are previously unpublished original papers and reviews. Of particular importance to metallurgists, design engineers and researchers, this volume relates directly to both current and future applications, such as liquefied natural gas pressure vessels, armor plate, and airframe hardware. It is a notable contribution to the literature.

The Campbell paper reviews the effect of test temperature on the toughness of materials. For many aluminum alloys, the fracture toughness tends to increase or remain generally constant as the testing temperature is decreased. Titanium alloys tend to have lower toughness as the testing temperature is decreased, but the effect is influenced by the alloy content and heat treatment. Alloy steels normally exhibit decreasing fracture toughness as the testing temperature is decreased through the transition temperature range, when the structure contains ferrite or tempered martensite. In the Rosenberg-Parris paper the mixed mode fracture toughness, K_Q, behavior of alpha-beta titanium alloys was examined in terms of: (1) alloy effects of aluminum, oxygen, and beta stabilizer, (2) processing effects of hot roll and anneal temperatures, and (3) test direction. Qualitatively, the oxygen, texture, and microstructural effects on K_Q parallel findings in the literature on titanium alloys regarding the effects of these variables on K_{Ic}. The paper by Adsit et al presents data on the high cycle fatigue behavior of Ti-5Al-2.5Sn. Tests were run in a liquid hydrogen environment and showed no directionality effect. The Hickey and Chait et al papers present data that characterize the static and dynamic mechanical properties of high hardness monolithic and laminar steel composites. It was found that toughness properties vary as a function of specimen orientation and that fatigue properties are maximized with improved as-received material surface and lowered humidity during testing. Low et al studied plastic fracture in five high-strength aluminum alloys (2014, 2024, 7075, and 7079). Their results show that ductility and fracture toughness are affected primarily by the size and volume fraction of the larger (1 to 10 μm) second-phase particles which contain iron or silicon or both. The Kaufman et al and Kelsey et al papers present data at cryogenic temperatures on the fracture toughness and fatigue crack growth rates for the aluminum alloys 5083-0 and 5183. Both of these materials are contenders for LNG applications; thus, the data presented in their papers are of considerable current interest.

Two other presentations that do not appear in this volume were made at the symposium:

1. Flow Growth Behavior During Proof Testing; by F. R. Schwartzberg; Martin-Marietta Corp., Denver, Colo.
2. Review of Soviet Titanium Alloys for Cryogenic Applications; by R. A. Wood; Battelle Columbus Labs., Columbus, Ohio.

Interested persons are referred to the authors for copies of the manuscripts.

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