Introduction

The metal matrix composite is a fairly new concept and approach to create materials of desired and unusual characteristics. Naturally many problems evolve with the attack of such a task, some in the fabrication, others in the application and the behavioral area under frequently occurring environments. This publication is attempting to consider, review, and contribute to the many arising questions in conjunction with metal matrix composites. It is based on papers given at a symposium on this subject at the Annual Meeting of the Society, co-sponsored by the Air Force Materials Laboratory, Dayton, Ohio.

An occasional review of the achievements during such a material development is always helpful to make the scientist and researcher aware of the problems and of the actual behavior of this material. In this relation it was thought that the papers presented at this symposium are significant for further work in the area.

Papers on vital areas of metal matrix composites are presented in this publication in an effort to disseminate the present knowledge on these materials and to prepare the path for advantageously applicable materials of this type. The series of papers is started with an introductory paper by H. M. Burte and C. T. Lynch and is followed by chapters on: (1) Influence of Specimen Fabrication on Mechanics and Properties of Metal Composites, (2) Micromechanics and Microstrains of Metal Composites and (3) Yield and Fracture Studies on Metal Composites.

In the first chapter the attention is focused by the author from the Space and Missile Division, General Electric Co., R. L. Mehan, on the factors involved in fabrication, preparation, and evaluation of alumina whisker wool reinforced aluminum and nickel composites. For the aluminum matrix material remarkable increases in strength compared to the matrix material are shown, and, for nickel the temperature limitation for the application, the behavior of the matrix and of the alumina whiskers were the most interesting features. Two other papers cover the fiber orientation and morphology on the tensile behavior of Al_3Ni whisker reinforced aluminum by F. D. George, J. A. Ford, and M. J. Salkind emphasizing the eutectic solidification method to produce composites and on residual stress studies of composites by H. R. Cheskis and R. W. Heckel, Drexel Institute of Technology, dealing with the important question of inherent residual stress systems in such materials and their effects in projected applications.

The second chapter includes a paper on microstrain behavior of metal composites by M. R. Pinnel, D. R. Hay, and A. Lawley, Drexel Institute of Technology, showing the particular sensitivity of magnesium-boron to annealing, the generally complex stress-strain relationship, and a tech-

nique effective for such an investigation. A paper on the mechanical behavior of aluminum-boron composite material by W. F. Stuhrke, Air Force Materials Laboratory, discusses the important synergism in these composites showing up to 30 per cent increase over the rule of mixtures and a significant contribution to the advancing materials technology. A study by J. R. Hancock and J. C. Grosskreutz, Midwest Research Institute, on the plastic yielding and strain distribution in filament-reinforced metals demonstrates the potential use of dislocation density measurements to determine the local plastic behavior in the matrix for characterization of interface behavior. Another investigation on micromechanics of aluminum-boron composites discusses the factors causing departures from elementary mathematical idealization and points the way for avoidance of unsatisfactory assumptions in the theoretical treatment of micromechanical analysis.

The third chapter focuses the attention on fracture behavior and time dependent loading of composites. The paper by D. Cratchley, A. A. Baker, and P. W. Jackson, England, discusses the stress-strain behavior dependent on stress level, the influence of nonalignment of the filaments, in this case SiO_2, the damping capacity, and the encouraging creep, stress rupture, and fatigue studies of the SiO_2-Al system. Another researcher R. C. Jones, Massachusetts Institute of Technology, examines the amount of strain hardening of 2024 aluminum reinforced with stainless steel by microhardness studies and the change in impression shapes at various locations in the composite due to triaxial restraint in the matrix. The paper by R. G. Gates and W. A. Wood, Columbia University, is concerned with the fatigue deformation of tungsten wires in a copper matrix composite. The reinforcement wires may act as a crack stopper.

The American Society for Testing and Materials thanks all the authors for their cooperation to present these vital areas of metal-matrix composite investigation. The discussion of such questions hopefully will advance the state-of-the-art for production and application of the new metal-matrix composite materials.

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