(4:00 p.m.)

CLOSED DIE FORGING OF BETA-C TITANIUM: D.E. Thomas, W.N. Love, RMI Co., 1000 Warren Ave., Niles, OH 44446; M.H. Rushen, LTV Steel Co., 2633 8th St. NE, Canton, OH 44701; R. Roeschlein, Fansteel/ Cal Drop Forge, 1033 Alhambra Ave., Los Angeles, CA 90012.

Renewed interest in beta titanium alloys has lead to studies aimed at improving microstructural uniformity while at the same time improving forgeability. Beta-C titanium forgings produced over a range of temperatures have been examined for macrostructure and microstructure before and after heat treatment. As-forged macrostructures exhibited varying uniformity with the finest grain size and most uniform structure produced at intermediate forging temperature. Lower forging temperatures produced a bimodal microstructure composed of recrystallized and unrecrystallized regions which could only be removed by high temperature solution heat treatments. Uniform microstructures produced at intermediate forging temperature appeared to undergo some recrystallization during the forging process with subsequent solution treatment completing the recrystallization process.

DISLOCATIONS AND INTERFACES IN SEMICONDUCTORS II: Topical Symposium

TOPICAL SYMPOSIUM

Sponsored by the TMS Electronic Device Materials Committee

Monday, January 25, 1988 2:00 p.m.

Room: Yuma 35 Phoenix Civic Plaza

Session Chairmen: L.C. Kimerling, AT&T Bell Labs., Murray Hill, N.J. 07974

G.A. Rozgonyi, Department of Materials Science and Engineering, North Carolina State University, Raleigh, NC 27695

See ad on page 94. Abstracts will appear in final program.

DISPERSION STRENGTHENED ALUMINUM ALLOYS I

Sponsored by the TMS Powder Metallurgy and Structural Materials Committees

Monday, January 25, 1988 2:00 p.m.

Room: Yuma 23 Phoenix Civic Plaza

Session Chairman: Young-Won Kim, Metcut-Materials Research Group, P.O. Box 33511, Wright-Patterson AFB, OH 45433-6533

(2:00 p.m.)

DISPERSION STRENGTHENING OF AL ALLOYS. Edgar A. Starke, Jr. and Heinz G. F. Wilsdorf, Light Metals Center, School of Engineering and Applied Science, University of Virginia, Charlottesville, VA 22901

The primary strength of dispersion hardened alloys is based on hindering dislocation motion through interactions with hard particles. These interactions depend on the sizes and shapes of dispersoids and their three-dimensional distribution, volume fraction, and the nature of the matrix/particle interfaces. Also, additional strength may be contributed by choosing a solid solution hardened matrix, by the presence of grain boundaries, and dislocation cell walls. In the past, the specific strength contributions were considered to be additive; however, in light of grain sizes below 1 μm for P/M dispersion hardened alloys this approach will have to be revised. Modern aluminum alloys, including Al_2O_3, carbon and lithium containing alloys, have been investigated and their microstructural features and strength properties will be related to the governing principles.

(2:35 p.m.)

STABILITY AND COARSENING OF DISPERSOIDS IN ALUMINUM ALLOYS:* M. E. Fine, Dept. of Materials Science & Engineering, Northwestern University, Evanston, IL 60201

Aluminum alloys for use at the highest temperatures require thermodynamically stable dispersoids which do not coarsen. The latter requires a low interfacial energy, low diffusivity and low solubility in the matrix. Further, strong interfaces to prevent debonding require low interfacial energy. The principles for obtaining low interfacial energy will be discussed with examples. These principles are good lattice matching, strong atomic bonding, and adsorption of solute at the interface. The nature of the atom bonding is also important since ductile metallic type bonds are desired. This points to intermetallic compounds which are in thermodynamically stable equilibrium with the aluminum alloy matrix as promising dispersoids.

* Supported by the AFOSR under Grant No. AFOSR-85-0337

(3:05 p.m.)

HIGH TEMPERATURE DEFORMATION OF DISPERSION STRENGTHENED MATERIALS: E. Arzt, Max-Planck-Institut für Metallforschung, Seestrasse 92, D-7000 Stuttgart 1, West Germany

The characteristics in the high temperature mechanical behavior of dispersion-strengthened materials are reviewed in the light of experimental results for aluminum-, nickel-, and iron-base alloys. All these materials show a highly stress-dependent creep behavior, and comparison of the results points to a common microscopic mechanism involving the interaction of lattice dislocations with the dispersoid particles. "Classical" models for dislocation climb are discussed and found to be inadequate. Instead, detailed transmission electron microscopy suggests a new concept for the mechanism of dispersion strengthening at high temperatures: dislocation motion at high temperatures is controlled by an attractive interaction with the dispersoid particles. The origins and theoretical consequences of such a mechanism are discussed. The improved scientific understanding is shown to result in new recommendations for the development of optimized materials which rely on dispersoids for high temperature strength.

(3:35 p.m.)

METHODS OF INTRODUCING DISPERSOIDS IN RAPID SOLIDIFICATION PROCESSING: N. J. Grant, Massachusetts Institute of Technology, 77 Massachusetts Avenue, 8-407, Cambridge, MA 02139

Rapid solidification (RS) processing offers unique opportunities for the introduction of stable refractory dispersoids for hardening and strengthening of metals. Such particulate incorporation can be done in the solid state using RS powders and flakes; however unusual advantages in terms of type, shape and size of particulates are possible by working in the liquid metallic state. Precipitation from rapidly quenched supersaturated solutions is one technique. Injection of particulates during atomization is an alternate technique permitting short dwell time at high temperatures, control of particulate size and shape, control of volume content of phases, and attainment of high density and fine grain size on deposition.

(4:05 p.m.)

COARSENING--A NEW APPROACH: G. J. Shiflet and J. A. Hawk, Dept. Materials Science, UVA, Charlottesville, VA 22901.

The presentation will suggest that, in addition to studying coarsening phenomenologically using the Wagner-Lifshitz-Slyozov (WLS) Theory, the mechanistic approach of Shiflet, Aaronson and Courtney (SAC) should also be utilized. It is clear that measuring precipitate radii at various stages of aging and plotting size versus a square or cube law is forcing a theory not developed for solid-solid phase transformations and its inherent interfacial anisotropy. The WLS theory does provide guidelines, such as minimizing interfacial energy, supersaturation and diffusivity of solute; however, descriptions of interfaces as coherent or incoherent do not address the question of how precipitates coarsen. The unique feature of the SAC approach is that an atomic mechanism has been identifie which is routinely observed experimentally and if it can be controlled, so also can coarsening.

(4:23 p.m.)

CREEP CRACK GROWTH IN Al-Fe-X RSP ALLOYS: S. F. Claeys, J. W. Jones, Dept of Materials Science and Engineering, University of Michigan, Ann Arbor, MI 48109, J.E. Allison, Ford Motor Co. Science Labs, Dearborn, MI 48121.

A study of creep fracture in Al-Fe-X RSP alloys shows that creep fracture results from the nucleation and growth of dominant creep cracks late in creep life. Research presented here investigates the mechanims of creep crack growth in this class of alloys. Several unique creep fracture morphologies have been identified, ranging from very brittle to areas with fracture strains approaching superplastic behavior on a microscale. Quantitative creep crack growth studies have related crack growth rate to stress intensity and have shown that fracture morphology is a sensitive function of crack growth rate. A model is formulated which relates microstructure and creep crack velocity to fracture mechanisms. A discussion is presented relating the characteristics of creep crack growth in these alloys to a generic class of dual phase materials.

(4:41 p.m.)

MECHANICAL PROPERTIES AND STRENGTHENING BEHAVIOR OF RAPIDLY SOLIDIFIED Al-8Fe-2Mo-Si ALLOYS. Vijay K. Vasudevan and Hamish L. Fraser, Dept. of Materials Science and Engineering, University of Illinois, Urbana, IL 61801.

This paper is concerned with the application of rapid solidification processing to Al-8Fe-2Mo alloys which are of interest for elevated temperature