Some Studies on the Superplastic Deformation Behaviour of a Ti-Al-Mn Alloy

B. Yogesha and S. S. Bhattacharya
Materials Testing Facility
Department of Metallurgical and Materials Engineering
Indian Institute of Technology Madras
Chennai-600036. India.
E-mail: byogi2001in@yahoo.com, ssb@iitm.ac.in
Ph: 91-044-2257 8602, 2257 0658

ABSTRACT

Superplastic titanium alloys (such as Ti-6Al-4V) have microstructures composed of □ and □ phases or are fully □. However, in these alloys, the alloying additions (like Vanadium or Molybdenum) are extremely expensive and so, there is a case for developing superplastic titanium alloys with cheaper alloying additions. One such possibility is a Ti-Al-Mn alloy (made as per the Russian specification, OT4-1) that could be a candidate material for replacing the expensive Ti-6Al-4V alloy. This alloy shows significant post-uniform deformation at ambient and near-ambient temperatures, and there is virtually little or no information available on its superplastic behavior. In the present investigation, tensile tests were carried out on this alloy in the temperature range of 1073 to 1173K (800 to 900°C) in the strain rate range of $1x10^{-5}$ to $1x10^{-2}$ s^{-1} in order to characterize the high temperature superplastic deformation behavior. A maximum elongation of 450% was observed at 1123 K at an initial strain rate of $5.52x10^{-4}s^{-1}$ indicating superplastic behavior of this alloy. From the obtained tensile test results, the optimum superplastic range of strain rate and temperature was found to be $1.38x10^{-4}$ to $1.38x10^{-3}$ s^{-1} and 1098 to1123 K. A hemispherical component of 90mm diameter was easily formed by a superplastic bulge forming technique with argon gas pressure of less than 1 MPa.

Keywords: Superplasticity, titanium alloys, elongation, strain rate and superplastic forming

Materials Processing for Properties and Performance (MP³) Vol. 3
Edited by K.A. Khor, R. V. Ramanujan, C. P. Ooi and J. H. Zhao
Institute of Materials East Asia, 2004