

HIGH TEMPERATURE CREEP OF TUNGSTEN FREE COBALT BASED SUPERALLOYS

Abhishek Sharma, Priyanka Agrawal, Prafull Pandey, Surendra Kumar Makineni, Dipankar Banerjee, and Kamanio Chattopadhyay

Department of Materials Engineering, Indian Institute of Science, Bangalore, India

Key Words: Cobalt based superalloys, tungsten free, creep

The current study reports the high temperature creep behaviour of the recently discovered^{1,2,3} Co-Al-Mo-Nb-Ta superalloys with additions of Ni, Cr and Ti. These alloys have a classical $\gamma - \gamma'$ microstructure, where the L_{12} ordered γ' is present uniformly throughout the γ matrix of cobalt in the form of coherent precipitates. The γ' in these alloys, has been stabilized without the addition of tungsten. This results in lower density as well as easier homogenization treatment, since slowly diffusing tungsten is absent. The solvus of these alloys is beyond 1000° C. The alloys exhibit excellent mechanical properties at higher temperatures, with specific strengths that are attractive compared to commercially available current cast polycrystalline cobalt based superalloys.

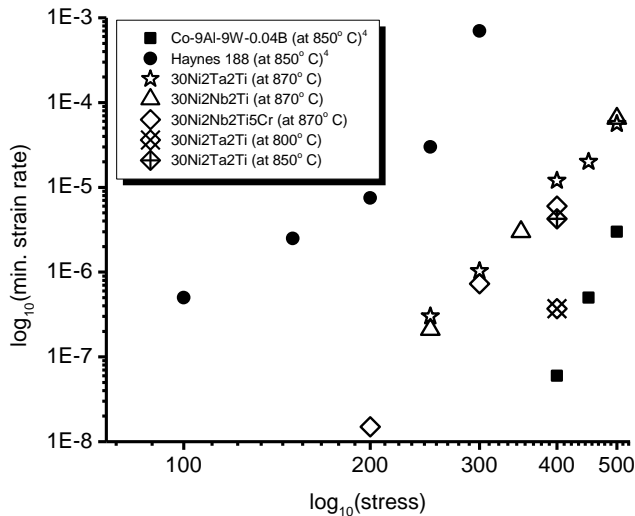


Fig 1: Steady state strain rate at different stresses and temperatures

In the present work, the creep deformation of these alloys has been studied at stress levels varying from 200 MPa to 500 MPa, and temperatures varying from 800°C to 870°C. The microstructures of the crept samples are described before and after creep. The activation energies of creep in steady state have been calculated those available in the literature for cobalt-based alloys. We shall additionally report dislocation structures associated with steady state creep.

Through these results, we shall endeavor to establish the possible application domain of these new alloys.

We thank the GTMAP program of ARDB, Government of India for support.

References:

- [1] S.K. Makineni, B. Nithin, K. Chattopadhyay, "A new tungsten-free $\gamma-\gamma'$ Co-Al-Mo-Nb-based superalloy", *Scripta Materialia*, **98** (2015), 36-39
- [2] S.K. Makineni, B. Nithin, K. Chattopadhyay, "Synthesis of a new tungsten-free $\gamma-\gamma'$ cobalt-based superalloy by tuning alloying additions", *Acta Materialia*, **85** (2015), 85-94
- [3] S.K. Makineni, A. Samanta, T. Rojhirunsakool, T. Alam, B. Nithin, A.K. Singh, R. Banerjee, K. Chattopadhyay, "A new class of high strength high temperature Cobalt based $\gamma-\gamma'$ Co-Mo-Al alloys stabilized with Ta addition", *Acta Materialia*, **97** (2015), 29-40
- [4] A. Bauer, S. Neumeier, F. Pyczak, R.F. Singer, M. Göken, "Creep properties of different γ' - strengthened Co-base superalloys", *Materials Science and Engineering A*, **550** (2012), 333- 341