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Abstract

Thermo-mechanical fatigue (TMF) tests including 0°, 90°, -90°, 45° -135° and -180°, phasing (φ) between mechanical loading and temperature were undertaken on a polycrystalline nickel-based superalloy, RR1000. Mechanical loading was employed through strain control whilst 300-700 °C and 300-750°C thermal cycles were achieved with induction heating and forced air cooling. Mechanical strain ranges from 0.7 to 1.4% were employed. Results show that, for the strain ranges tested, TMF life is significantly affected by the employed phase angle. Furthermore the strain range and peak cycle temperature used has a substantial influence on the significance of dominant damage mechanisms, and resultant life. Various metallographic examination techniques have outlined that the dominant damage mechanisms are creep deformation at higher temperatures and early cracking of oxide layers at lower temperatures.

Introduction

It has long been known that TMF loading can be more damaging than typical isothermal fatigue (IF). Increasing operating temperatures to improve cycle efficiency and mechanical loading to enhance performance in conjunction with weight reduction strategies that include