TCR Advanced Engineering P. Ltd

Experts in Metallography, Failure Investigation and RLA

Metallurgy for Industries

Power | Petrochemical | Fertilizer | Chemical | Refinery | Engineering | Automobile

A Monthly News Letter May, 2015 **Volume 29**

Rejuvenation Technology for Hot Gas Path Components of Gas Turbine.

An introduction

Gas turbine blades and nozzle guide vanes are very expensive components and exposed to high temperature (~ 1200 deg C) in a gas turbine (industrial gas turbine or aeroengine). The efficiency of gas turbine is proportional to the temperature of the hot gases running through the blades & vanes. The turbine section reaches highest temperature and is one of the highest stressed parts of the gas turbine. Rotor blades are most critical parts of a gas turbine. They experience a lower temperature than the vanes, but are subjected to high centrifugal stresses. Rotor blades and stator vanes have the most stringent materials requirements (creep, strength, ductility and hot corrosion resistance). The material development was driven by commercial pressures which are based on the considerations of lower component cost, life cycle cost and maintenance cost.

Creep is the dominant mode of deformation in gas turbine blades at operating stresses and temperatures. The accumulations of creep damages in these components degrade its properties. Therefore, effective utilization of these components requires a technology for reclaiming the original structure & properties at periodic intervals. Recovering the service induced creep damage is called rejuvenation. This consist of three parts, i.e.,

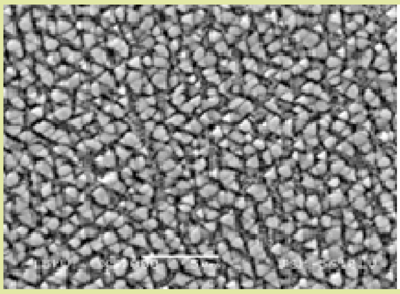
(i) Quantification of microstructural degradation incurred by the turbine parts during service exposure.

(ii) Identification of metallurgical parameters/treatments for reclaiming optimum microstructures and creep properties.

(iii) Assessment of amount of damage repaired upon rejuvenation.

At present, some proprietary technology is available through American & European gas turbine manufacturers. It was felt that an indigenous rejuvenation technology must be developed in India. The rejuvenation technology aims to develop heat treatment schedules for rejuvenation of engine-run turbine components through microstructural control. The viability of rejuvenation of

Microstructure of the Month



Magnification: *5000X*

Etchant : 10%Cro3

MOC: Inconel 738LC

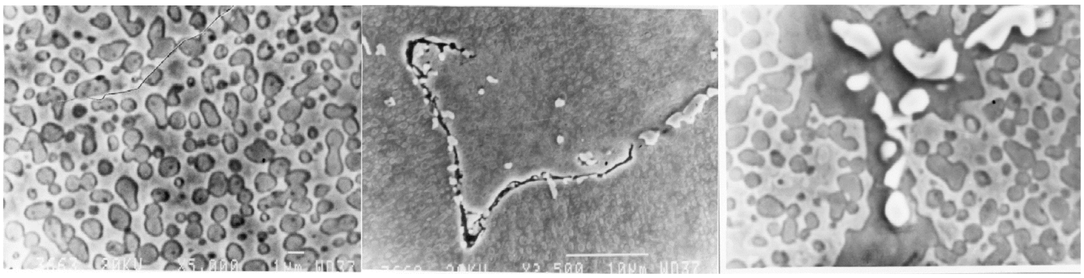
Component: Gas turbine blade

Observation: is the high magnification view of the gamma prime precipitates. Their morphology is cuboidal / triangular in shape.

Useful hints: Morphology of gamma prime determines the useful service life of the component. Metallography approach determines the remaining life of the blade and also indicates the possibility of rejuvenating the costly gas turbine components.

long-time exposed materials depends on the understanding of the detrimental structural phase transformations during operation. In order to develop this technology, the following fundamental studies have to be explored: i) Structural characteristics of phases and its transformation sequences during high temperature exposure, ii) Thermal stability of phases, iii) Studies on the heat treatment and hot isostatic pressing (HIP) schedules to regenerate the original microstructure. A number of alloy specific protocols for rejuvenation have been developed and transferred to gas based power industries.

1st stage turbine rotor blades of an aero engine (top) and IGT (bottom).



Microstructural degenerations in turbine blade made of IN 738 LC: matrix γ'-coarsening, grain boundary cavitation and transformation of grain boundary precipitates.

* * *

For Further details Contact us at testing@tcradvanced.com , Ph: +91-7574805595