

NEW MATERIALS

Heat-resistant nickel alloys for repair and manufacture of aircraft and ground engine gas turbine components

Description

Components of gas turbine units operate under severe conditions at temperatures of up to 1300 °C. These components are made from heat-resistant high-nickel alloys containing a high amount of γ' -phase. High heat resistance is achieved through a high degree of alloying, and through ensuring of structure with directed solidification or of a single-crystal type. The alloys are characterized by a high sensitivity to cracking in making of permanent joints or in repair of components. Investigations into weldability of such alloys were conducted by the E.O.Paton Electric Welding Institute and Pratt & Whitney – Paton (Kyiv, Ukraine) in collaboration with Oak Ridge National Laboratory (Knoxville, USA). The investigation results proved the feasibility of producing sound joints with a different level of strength and service properties at high temperatures.

New joining methods make it possible to produce monolithic all-welded members of structures, providing a substantial extension of their life, instead of mechanical fixing of blades in disks and mechanical joining of individual assemblies. These methods passed the tests, and now they have found application in repair operations and addressing the problems associated with extension of residual life of structures.

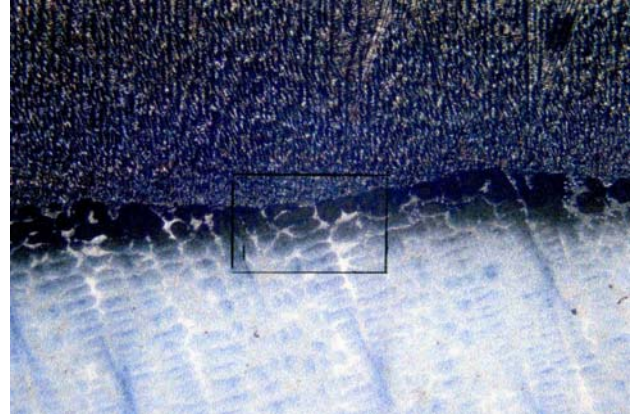
Innovative Aspects and Main Advantages

Electron beam welding, microplasma welding, electric spark cladding, microplasma spraying, brazing process modifications, and precision A-TIG welding allow selection of processes to provide the highest quality and address the following problems, depending upon the composition and heat resistance of nickel alloys:

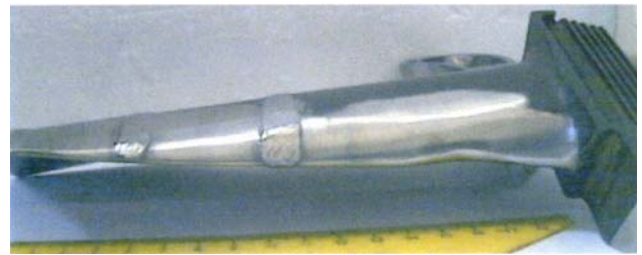
- repair of blades and vanes, and extension of their lives;
- manufacture of monolithic members of gas turbine units of the blisk type;
- production of sound joints in a new generation of structural materials with a high content of intermetallic phase;
- arrangement of a specialized workshop for repair of gas turbine unit components made from heat-resistant high-nickel and intermetallic alloys.
- estimation of actual residual life of gas turbine unit components, and assignment of methods for restoration of their service life.

Areas of application

Aircraft engines, marine and ground gas turbine units, steam turbines, and high-pressure compressors.



Pic. 1 Structure of weld ChS-70.



Pic2. Repair welding on blade of alloy EP 539

Stage of development

Technology, life estimation methods and equipment can be adapted to customer's needs. Technologies can be demonstrated and verified at experimental workshops.

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