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High Temperature Properties of Diffusion Brazed Joints of in 939 Ni-Base Superalloy

Authors : Hyun KI Kang, Hi Won Jeong

Abstract : The gas turbine operates for a long period of time under harsh, cyclic conditions of high temperature and pressure, where high turbine inlet temperature (TIT) can range from 1273 to 1873K. Therefore, Ni-base superalloys such as IN738, IN939, Rene 45, Rene 71, Rene 80, Mar M 247, CM 247, and CMSX-4 with excellent mechanical properties and resistance to creep, corrosion and oxidation at high temperatures are indeed used. Among the alloying additions for these alloys, aluminum (Al) and titanium (Ti) form gamma prime and enhance the high-temperature properties. However, when crack-damaged high-temperature turbine components such as blade and vane are repaired by fusion welding, they cause cracks. For example, when arc welding is applied to certain superalloys that contain Al and Ti with more than 3 wt.% and T3.5 wt%, respectively, such as IN738, IN939, Rene 80, Mar M 247, and CM 247, aging cracks occur. Therefore, repair technologies using diffusion brazing, which has less heat input into the base material, are being developed. Analysis of microstructural evolution of the brazed joints with a base metal of IN 939 Ni-base superalloy using brazing different filler metals was also carried out using X-ray diffraction, OEM, SEM-EDS, and EPMA. Stress rupture and high-temperature tensile strength properties were also measured to analyze the effects of different brazing heat cycles. The boron amount in the diffusion-affected zone (DAZ) was decreased towards the base metal and the formation of borides at grain boundaries was detected through EPMA.

Keywords : gas turbine, diffusion brazing, superalloy, gas turbine repair
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