Communication

Influence of Solid-State Diffusion during Equilibration on Microstructure and Fatigue Life of Superalloy Wide-Gap Brazements

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The influence of solid-state diffusion-controlled solute loss into additive powder particles (APPs), as determined by particle size, during the equilibration stage of wide-gap brazing, on microstructure and fatigue behavior of a brazed aerospace superalloy was studied. The results, which experimentally confirm previously reported numerical model simulation results, show that, in order to avoid degradation of fatigue life of wide-gap brazement, adequate solute-loss into the APPs, which is necessary to prevent their complete melting, but has not been generally considered, is imperative.

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Precipitation-strengthened cast nickel-based superalloys are used for manufacturing hot-section components of aero and land-based gas turbine engines, because of their remarkable high temperature mechanical strengths and hot-corrosion resistance. The demand for higher efficiencies, which require turbine engines to operate at higher temperatures, has led to increased degradation of engine components through higher levels of creep, fatigue, and oxidation. It is generally more economically attractive to repair damaged parts instead of going for a complete replacement. Traditional repair techniques, such as welding, are commonly used in the repair of many superalloy components. However, precipitation-strengthened cast nickel-based superalloys, like Inconel 738 (IN 738), are generally difficult to weld because of their high susceptibility to weld cracking.1,2 Wide-gap brazing is an alternative technique for joining and repairing gas turbine engine components made of difficult-to-weld superalloys.3-9 The technique often involves the use of composite powder mixture as the interlayer material. The powder mixture consists of regular brazing filler alloy powder that contains melting point-depressant (MPD) solute and an additive powder.