

HIP diffusion bonding of PM superalloy disk and cast superalloy blade rings for dual-alloy turbine wheels

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Dual-alloy turbine wheels produced by HIP diffusion bonding of vacuum investment cast blade rings of the cast superalloy K418B to preconsolidated powder metal hubs of the powder metallurgy (PM) superalloy FGH4091, which have the long cyclic lives characteristic of PM superalloys combined with the high creep strength and net-shape blades characteristic of cast superalloys. After machining, the consolidated hubs and blade rings are cleaned, assembled, hot degassing at about 500°C and then sealed in vacuum less than 1.0×10^{-3} Pa. Finally, the sealed disk and blade rings are HIPed at 1160–1200°C/130 MPa/4h, so as to diffusion bonding with each other completely. The diffusion-welded joint is characterized for microstructural features, diffusion of alloying elements and tensile properties. Microstructure is investigated by scanning electron microscopy (SEM) and electron probe micro-analyzer (EPMA). The results showed that the joint is integral without any defects, such as inclusions and continuous distribution of the second precipitates. EPMA further revealed the width of diffusion zone is about 100 micrometers. The diffusion of elements Co, Ni, Al, Cr, Ti, Nb, Mo is gradually weakened, which is caused by their vary diffusion constants. Specimens showed good weld strength, all the tensile specimens are failed at the cast superalloy.

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