

The effect of element Hafnium on the microstructure and mechanical properties of as-HIPed FGH4097 PM superalloy

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FGH4097 is a new type of powder metallurgy (PM) superalloy developed in China. It is mainly used as the key hot end components for the advanced aero-engines, for instance the turbine disc and compressor disk etc. Powders of FGH4097 alloy were produced by plasma rotating electrode process (PREP) firstly, and then consolidated into billets with a size of $\Phi 80 \times 135$ mm by hot isostatic pressing (HIP). The size of FGH4097 alloy powder canned is +50 -150 μ m. The HIPed condition is 1180~1220°C/130MPa/4h. The billet is heat treated by solid solution, and then aged three times. The influence of element Hafnium with different content on the grain size, γ' phase, MC carbide in as-HIPed FGH4097 alloy was studied by means of metallurgical microscope, scanning electron microscope and physiochemical phase analysis. And the major mechanical properties of each PM superalloy were investigated, such as tensile properties, stress rupture properties, and fatigue crack propagation rate. The results showed that Hf had no effect on the grain size, the size of γ' phase, and the size and morphology of MC carbide. But Hf promoted the precipitation of γ' phase and MC carbide, and changed the chemical composition of γ' phase and MC carbide, and accelerated the splitting of γ' phase from one instable cubic particle to stable octet of cubes. Appropriate Hf content was helpful for improving mechanical properties, such as impact ductility, tensile plasticity, stress rupture life, and fatigue crack propagation resistance. FGH4097 PM superalloy containing 0.30% Hf presented the best comprehensive mechanical properties.

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Materials

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