CVD 关键工艺参数对(Ni, Pt)Al 涂层高温防护性能影响*

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摘 要: 采用化学气相沉积(CVD)工艺,在不同沉积温度和沉积真空度下分别在镍基单晶合金上制备了三种(Ni,Pt)Al 涂层,研究了 CVD 关键工艺参数对(Ni,Pt)Al 涂层高温防护性能的影响。借助 X 射线衍射仪(XRD)、扫描电子显微镜(SEM)和能谱仪(EDS)等表征方法系统分析了三种(Ni,Pt)Al 涂层的相结构、显微组织和化学成分。结果表明:在同一沉积真空度下随着沉积温度升高,涂层衍射峰向大角度方向偏移;在同一沉积温度下随着沉积压力变大,涂层衍射峰向小角度方向偏移;随着沉积温度和沉积压力的同时提升,涂层表面的晶粒尺度呈现增大趋势,涂层厚度也随之增加;经 1 100 ℃/250 h 静态氧化和 900 ℃/100 h 燃气热腐蚀性能评价后,沉积温度为 1 080 ℃且沉积真空度为 300 mbar 的涂层样品,其氧化动力学增重值均小于其他两种涂层样品,该工艺制备的涂层高温防护性能最佳。控制涂层表面局部位置氧化膜内显微裂纹的过早萌生与滋长行为,以及降低燃气热腐蚀诱发的非稳态氧化膜脱落残留的凹坑数量是改善(Ni,Pt)Al 涂层高温抗氧化腐蚀性能的 CVD 工艺优化方向。

关 键 词: 化学气相沉积;(Ni,Pt)Al 涂层;沉积温度;沉积真空度;防护性能

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Influence of Critical CVD Processing Parameters on High Temperature Protective Performance of (Ni,Pt)Al Coatings

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Abstract: Three kinds of (Ni, Pt)Al coatings were fabricated on nickel-based single crystal superalloy via chemical vapor deposition (CVD) technique at different deposition temperature and deposition pressure. The influence of critical CVD processing parameters on the high temperature protective performance of (Ni, Pt)Al coatings was systematically investigated. The phase constituent, microstructure and chemical content of the three (Ni,Pt)Al coatings were analyzed by XRD, SEM and EDS. The results show that with the increment of deposition temperature, the diffraction peaks of (Ni,Pt)Al coatings shift to a large 2θ-degree at the same deposition pressure. However, at the same deposition temperature, the coating diffraction peaks shift to a small 2θ-degree at the elevated deposition pressure. The grain size of the coating tends to become larger and the thickness of the coating correspondingly turns into thicker accompanying with the increment both of deposition temperature and deposition pressure. After evaluation of isothermal oxidation (1 100 ℃/250 h) and gas hot corrosion (900 ℃/100 h), the oxidation kinetic weight gain of the coating specimen with deposition temperature of 1 080 ℃ and deposition pressure of 300 mbar is less than that of the other two types of coating samples, and the (Ni, Pt)Al coatings prepared by this process has the best high temperature protective properties. Controlling the premature initiation and growth of microcracks in the oxide film at local position on top of coating surface, and reducing the number of microholes caused by hot corrosion are the trend of CVD processing optimization to improve the high temperature oxidation-resistance and corrosion-resistance of (Ni,Pt)Al coatings.

Key words: CVD; (Ni,Pt)Al coating; deposition temperature; deposition pressure; protective performance

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