

研究论文

一种镍基单晶高温合金压缩变形的各向异性

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摘要: 将一种镍基单晶高温合金在室温沿不同晶体取向压缩变形, 研究了在试样表面形成的滑移线和微观组织的变化。结果表明: 这种合金<111>取向试样的屈服强度最高, <001>取向的强度最低, <110>取向的强度居中。<001>和<110>取向的试样在压缩变形过程中主要启动八面体滑移系, 其中<110>取向明显观察到双滑移系的开动; 而<111>取向的试样则启动了六面体滑移系。基体通道、枝晶、共晶等组织的各向异性, 在一定程度上影响不同晶体取向合金的变形特征。<110>取向试样的变形组织中形成了大量的层错, 而在其它两个取向的试样中则未观察到。<111>取向变形后基体通道中的位错密度明显高于其它两个取向, 这种高加工硬化率使<111>取向具有高的屈服强度。

关键词: 金属材料 镍基单晶高温合金 压缩变形 滑移线 各向异性

Compression Deformation of a Nickel-Base Single Crystal Superalloy of Different Orientations

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Abstract: A nickel base single crystal superalloy was compressed at room temperature along the <001>, <110> and <111> orientations, respectively. The evolution of the slip traces and the microstructure in the deformation was investigated by metallographic microscope and transmission electron microscope. It was found that compress deformation depends on the crystal orientation and the precedence of the compress yield stress is: <111>, <110>, <001>. For the <001> or <110> oriented specimen compressed 4.5% the slip traces match the octahedral slip, and the slip traces in the <111> oriented alloy prove to slip along the {001} planes. It is noted that deformation of the <110> oriented alloy takes place by activation of two slip systems. The anisotropy of the matrix channel, dendritic segregation and eutectic leads to the change of deformation behavior for various orientations. For the <110> oriented alloy γ' particles cut by stacking fault. The high dense dislocation of the <111> oriented alloy contributes to its high yield strength.

Keywords: metallic materials nickel-base single crystal superalloy compress slip trace anisotropy

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