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TiNiFeNb形状记忆合金的组织结构及相变特性

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Microstructure and Transformation Behavior of TiNiFeNb Shape Memory Alloys

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摘要 通过向$Ti_{50}Ni_{50}$合金中加入Fe和Nb元素,制备出一种四元$Ti_{49}Ni_{50-x}Fe_xNb_1$形状记忆合金。采用X射线衍射和背散射电子衍射的方法,测试和分析了合金的相结构及微观组织形态,采用电阻法系统研究了合金的相变特性。结果表明:Nb元素的加入并没有改变TiNiFe合金的B2结构,仅导致了极少量的富Nb相在基体中析出。但是Nb元素的加入抑制了合金相变过程中R相的产生;随着Fe元素原子分数从1%提高到3%,合金的马氏体相变开始温度从273.7 K急剧降低至137.2 K。另外,$Ti_{49}Ni_{47}Fe_3Nb_1$形状记忆合金表现出良好的形状记忆效应。当预应变为8%时,合金的应变回复率达到了92.66%。

关键词: 形状记忆合金 $Ti_{49}Ni_{50-x}Fe_xNb_1$ 微观组织结构 相变特性 形状记忆效应

Abstract: A series of quaternary shape memory alloys $Ti_{49}Ni_{50-x}Fe_xNb_1$ (at%) are prepared by adding elements Fe and Nb into alloys $Ti_{50}Ni_{50}$. The microstructure morphology and phase transition behavior of these alloys are studied systematically by X-ray diffraction, backscattered electron and electrical resistance measurements. It is shown that the addition of Nb does not change the phase structure of alloy TiNiFe (B2) and it just causes a tiny quantity of Nb-rich phase to precipitate in the matrix. However, the Nb addition inhibits the appearance of the R-phase in the process of phase transformation. With the increase of Fe content from 1 at% to 3 at%, the martensitic transformation temperature decreases rapidly from 273.7 K to 137.2 K. In addition,shape memory alloys $Ti_{49}Ni_{47}Fe_3Nb_1$ exhibites good shape memory effect and its strain recovery rate reaches 92.66% after a pre-strain of 8%.

Keywords: shape memory alloys $Ti_{49}Ni_{50-x}Fe_xNb_1$ microstructure transformation behavior shape memory effect

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