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论文

铁基合金中板条马氏体帐篷型表面浮凸位移的定量分析

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摘要:

表面浮凸伴随着丰富的相变晶体学信息, 对板条马氏体表面浮凸的形状应变进行研究, 可以获得相变过程中累积的长程应变场的晶体学信息, 进而实现对相变应变场和界面结构的准确描述. 本文对Fe-20.2Ni-5.5Mn(质量分数, %)合金中板条马氏体表面浮凸进行系统地定量表征, 并借鉴双面金相位移合成法合成单面样品浮凸的位移矢量. 采用原子力显微镜(AFM)结合电子背散射衍射(EBSD)观察到该合金中板条马氏体浮凸呈帐篷型. EBSD统计分析显示板条马氏体与基体之间位向关系接近K-S关系, 它们的惯习面接近$(111)_f$, 合成的位移矢量分散在$[121]_f$附近, 最大切变角为27.49°. 实验中采用AFM观察到的浮凸角为22.41°, 小于合成得到的最大切变角, 这可能由于惯习面不垂直于自由表面所致.

关键词: 相变晶体学 板条马氏体 表面浮凸 形状应变

QUANTITATIVE ANALYSIS FOR THE DISPLACEMENT OF TENT–SHAPED SURFACE RELIEF OF LATH MARTENSITE IN Fe–BASED ALLOY

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Abstract:

Lath martensite with a dislocation substructure is one of the most common forms of martensite in structural steels. Surface relief has been regarded as an important characteristic in the martensitic transformation. Crystallographic features on surface relief are essential to get into deep insight of the long range strain field in the transformation, and explore the mechanism of the phase transformation. However, very limited experimental data on the shape strain associated with the formation of surface relief caused by the lath martensite have been reported so far, especially for the quantitative study of the displacement vector. The present investigation was carried out to study the shape deformation in the formation of the lath martensite on the austenite matrix in an Fe–20.2Ni–5.5Mn (mass fraction, %) alloy. The shape strain accompanying surface relief, such as the magnitude and direction of the displacement vector, has been concerned in a quantitative way. The morphology of the relief was studied by the optical microscope (OM) and the atomic force microcope (AFM). The orientations of the matrix grain and the lath were measured by the electron backscattered diffraction (EBSD), respectively, which was used to determine the orientation of the habit plane, and the orientation relationship (OR) between the lath martensite and its neighboring matrix. Combing the data from EBSD and AFM, it is concluded that the relief is produced by a single bcc crystal, which exhibits a tent-shaped relief. Based on an electron backscattered diffraction analysis, the ustenite/martensite orientation relationship is found to be in the closer vicinity of K–S orientation relationship, which is consistent with that in bulk materials obtained by transmissin electron microscope (TEM), and the habit plane is determined to be near $(111)_f$. The largest shear angle for the relief is calculated to be 27.49°, and the directions of comined displacement vector are scattered around $[121]_f$. However, the bserved maximum surface tilt angle is 22.41°, which is smaller than the calculated value. Considerinthe habit plane is not perpendicular to the pre–polishing surface, the measured smaller value f tilt angles is reasonable.

Keywords: phase transformation lath martensitesurface relief shape strain

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