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TC4钛合金锥形环热辗轧应变及温度场对轧辊尺寸的响应规律

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Response Rules of Strain and Temperature Fields to Roll Sizes During Hot Rolling Process of TC4 Titanium Alloy Conical Ring

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摘要

提出采用等效半径来描述锥形轧辊(驱动辊和芯辊)及锥形环坯的呈线性变化的径向尺寸,进而建立了确定锥形环件辗轧关键工艺参数合理范围的方法。基于ABAQUS软件平台,研究建立了TC4钛合金锥形环热辗轧三维热力耦合有限元模型,进而模拟阐明了TC4钛合金锥形环热辗轧过程应变及温度场对轧辊尺寸(等效半径)的响应规律与机理。主要结果表明:随着驱动辊等效半径增大,环件内侧等效塑性应变及温度明显增大,环件温度分布越均匀;随着芯辊等效半径增大,环件内侧等效塑性应变及温度明显减小,温度分布越不均匀;驱动辊和芯辊各存在一个最佳的等效半径,使得环件应变分布最均匀。

关键词： 钛合金 锥形环 环件轧制 轧辊尺寸 等效半径 热力耦合

Abstract:

A parameter of equivalent radius is proposed to describe the linearly changing radial sizes of the conical rolls and conical ring blank. Then a method to determine the reasonable range of the key process parameters for conical ring rolling is presented. Under the ABAQUS software environment, a coupled thermo-mechanical 3D-FE model is developed for hot conical ring rolling of TC4 titanium alloy, and the response rules and mechanism of strain and temperature fields to roll sizes are numerically revealed during the process. The main results show that: with the increase of the equivalent radius of the main roll, the equivalent plastic strain and temperature increases obviously in the inside surface layer of the ring, and the temperature distribution of the whole rolled ring becomes more homogeneous, with the increase of the equivalent radius of the mandrel, the equivalent plastic strain and temperature decrease obviously in the inside surface layer of the ring, and the temperature distribution of the whole rolled ring becomes more inhomogeneous, and for the main roll and the mandrel, there is a respective optimum equivalent radius at which the strain of the rolled ring is most evenly distributed.

Keywords: titanium alloys conical ring parts ring rolling roll size equivalent radius thermal-mechanical coupling

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