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组合线圈磁场下的液桥热表面张力流

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THERMOCAPILLARY FLOW IN LIQUID BRIDGE UNDER MAGNETIC FIELD GENERATED BY COMBINED COIL CONFIGURATIONS

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摘要

为了优化外加磁场对对流控制作用,该文主要研究了轴向载流线圈磁场,横向四载流线圈磁场及其组合磁场对液桥热表面张力对流的控制.研究结果表明:轴向载流线圈磁场可有效抑制熔体的径向流动,并改善熔体对流的轴对称性;而横向载流线圈磁场可有效地抑制熔体轴向的对流,但是会破坏熔体对流的轴对称性.合理布置的轴向载流和横向四载流线圈的组合磁场同时保留了轴向载流线圈磁场的轴对称影响和横向四载流的轴向抑制作用,可以达到更好的控制熔体对流的效果,有利于从浮区法晶体生长中获得高质量晶体.

关键词: 热表面张力流 磁场 对流控制 浮区法 晶体生长 数值模拟

Abstract:

In order to optimize convection control in a liquid bridge, the effects of the magnetic fields generated respectively by axial coils, transversal coils and their combination on thermocapillary flow are investigated. The results demonstrate that the magnetic field produced by axial coils can help suppress melt flow in the radial direction and improve the axisymmetry of a convection structure; and that the magnetic field produced by transversal coils, however, may break the axisymmetry of a convection structure while damping melt flow in the axial direction. Furthermore, the coupled favorable effect, weakened melt flow in the axial direction with an axisymmetrical convection structure, is obtained under the magnetic field produced by the combination of axial coils and transversal coils, thereby attaining a better effect on melt convection, and therefore high-quality crystal in floating zone crystal growth.

Key words: thermocapillary flow magnetic field convection control floating zone crystal growth numerical simulation

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