



论文摘要

中南大学学报(自然科学版)

ZHONGNAN DAXUE XUEBAO(ZIRAN KEXUE BAN)

Vol.40 No.3 Jun.2009

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文章编号: 1672-7207(2009)03-0562-06

大型铝电解槽母线配置的数值仿真与优化

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摘要: 通过运用商业软件ANSYS与自编程序相结合的方法, 建立铝电解槽母线配置的参数化仿真计算模型, 并基于磁流体稳定性评估准则采用遗传算法研究500 kA铝电解槽的母线配置及其优化。研究表明, 自适应优化后的母线在槽底为非对称强补偿母线配置方式, 阴极母线电流的配置在大面A侧为67:5:0:2:4:, 在大面B侧为3:4:8:5:4, 具有较好的物理场分布特征与磁流体稳定性, 铝液中部垂直磁场极值为38.7 Gs, 铝液层的平均流速为0.148 m/s。通过运用现代遗传优化技术能够实现多物理场下的目标优化, 实现对母线配置参数组合的自动优化选择以及多物理场的优化配置。

关键词: 铝电解槽; 磁流体稳定性; 母线配置; 数值仿真

Numerical simulation and optimization of busbar configuration in large aluminum electrolysis cell

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Abstract: Using commercial package ANSYS and custom code, the parametrical mathematic model of busbar configuration in the 500 kA aluminum electrolysis cell was proposed, and the busbar configuration along with the physical fields was studied and optimized based on the MHD (magnetohydrodynamic) stability criteria with genetic algorithm. The results show that the cell with optimized asymmetrical busbar configuration has better performance in the distribution of physical fields and MHD stability; the current carried by the cathode busbars along A side is at ratio of 67:5:0:2:4:, while along B side is at ratio of 3:4:8:5:4; the maximum of B_z in the mid metal is 38.7 Gs and the average velocity of metal is 0.148 m/s. The approach combined with genetic algorithm and stability evaluation criterion can effectively achieve an optimal design of busbar configuration and multi-physical fields.

Key words: aluminum electrolysis cell; magnetohydrodynamic stability; busbar configuration; numerical simulation

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