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软接触电磁连铸高频调幅磁场作用规律的瞬态分析

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摘要: 利用软接触电磁连铸过程电磁场计算模型, 对方波和正弦波调幅磁场进行瞬态分析, 研究调幅激励电流密度与结晶器内金属液中的磁感应强度和电磁力之间的响应关系。结果表明: 磁感应强度幅值与激励电流密度幅值呈正比关系, 两者随时间变化规律一致; 调幅磁场磁感应强度变化频率与高频激励电流密度的频率一致, 且磁感应强度幅值和磁感应强度变化频率都与调幅波的频率无关, 这是通过电流密度调幅获得调幅磁场的依据; 调幅磁场电磁力与调幅磁场磁感应强度的平方成正比, 与调幅电流密度的平方成正比, 电磁力幅值变化周期与调幅电流密度幅值变化周期一致, 电磁力变化频率是高频激励电流密度变化频率的两倍。这给调幅磁场通过控制激励电流密度来控制电磁力提供了依据。

关键字: 电磁连铸; 高频调幅磁场; 瞬态分析; 磁感应强度; 电磁力

Transient analysis of high frequency amplitude-modulated magnetic field during soft-contact electromagnetic continuous casting

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Abstract: A calculation model of electromagnetic field in soft contact electromagnetic continuous casting process was developed and a transient analysis on electromagnetic field amplitude-modulated with sine wave and square wave was carried out. The responsive relation of magnetic induction density (B) and electromagnetic force (F_{em}) to exciting current density of amplitude-modulate magnetic field (AMMF) was investigated via the model. The results show that the amplitude of magnetic induction density (B_m) is in direct proportion to the amplitude of exciting current density (J_m). The frequency of B is consistent with that of exciting current density. Both B_m and frequency of B are independent of the frequency of modulating wave. The results are theoretical basis of AMMF induced by modulating the exciting current density. The value of F_{em} is in

direct proportion to the square of magnetic induction density as well as the square of the exciting current density. The variation cycle of amplitude of F_{em} is consistent with that of J_m . The frequency of F_{em} is doubled that of exciting current density. The results are bases for controlling F_{em} by adjusting exciting current density.

Key words: electromagnetic continuous casting; high frequency amplitude-modulated electromagnetic field; transient analysis; magnetic induction density; electromagnetic force

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