(6) Contribution to the Phenomena Occurring at the Metal Meniscus in an Oscillating Mold in Continuous Casting (Miscellany)

(5) 鉄鋼製精錬プロセスの界面物理化学的研究

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現在の鉄鋼製精錬技術の根幹は不均一反応系の合理的利用にあるといっても過言ではない．スーパーメタル，複合材料など，既存の金属材料を超える材料の開発をめざす場合にも，そのプロセッシングあるいはめざす材料自身が関与する不均一系の理解と応用が，開発を成功へと導く一つの有力な道になりうると思われる．これらの不均一系は，高い表（界）面張力を持つ液体金属や酸化物などで構成されており，そのうえ酸素，硫黄などの強力な界面活性成分が存在するので，界面化学を中心とする界面物理化学による界面現象の理解と応用が特に重要になると考えられる．筆者らのこれまでの製精錬プロセスの界面物理化学的研究の例を紹介し，そのことを踏まえて，スーパーメタルなどの材料開発のためのプロセス研究に対する現在の課題，将来の方向についても言及する．

(6) Contribution to the Phenomena Occurring at the Metal Meniscus in an Oscillating Mold in Continuous Casting

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In this lecture three investigations on the transient phenomena at the metal/slag interface in a continuous casting mold will be treated.

Dynamic form of meniscus : Cold model experiments have been carried out involving the mercury/oil system and high speed photography to determine the variation of meniscus form at an oscillating wall. Furthermore, the meniscus shape was computed theoretically by solution of the Navier–Stokes and continuity equations. It was found that the meniscus behaves highly dynamically. There may even be a convex meniscus during the positive strip time.

Shell thickness transients at the meniscus : A heat flow analysis was preformed using the finite-element method to compute the temperature field and the thickness of the solid shell in the meniscus region. The convection in the liquid is determined with the fluid flow model. The effects of superheat and of oscillating heat flux density is computed finding that the tip of the solid shell may move upwards and downwards by several millimeters during one oscillation cycle.

Deformation of solid shell : A mechanical model of the bending of the solid shell has been developed. It takes into account the downwards movement of the shell and viscoplastic material behavior. The pressure fluctuations in the casting flux layer between shell and mold are obtained from the Reynolds differential equation. The theoretical surface contour of the shell clearly shows "oscillation marks". The model is used to predict the effects of frequency and amplitude of the mold oscillation, and of casting rate on the depth of the oscillation marks.