

# **Inclusion Flotation-Driven Channel Segregation in Solidifying Steels**

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**Channel segregation, which is featured by the strip-like shape with compositional variation in cast materials due to density contrast-induced flow during solidification, frequently cause the severe destruction of homogeneity and some fatal damage. An investigation of its mechanism sheds light on the understanding and control of the channel segregation formation in solidifying metals, such as steels. We discover a new force of inclusion flotation that drives the occurrence of channel segregation. It originates from oxide-based inclusions ( $Al_2O_3/MnS$ ) and their sufficient volume fraction-driven flotation becomes stronger than the traditionally recognised inter-dendritic thermosolutal buoyancy, inducing the destabilisation of the mushy zone and dominating the formation of channels. This study uncovers the mystery of oxygen in steels, extends the classical macro-segregation theory, and highlights a significant technological breakthrough to control macro-segregation.**