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Motion behaviors of non-metallic inclusions at the steel/Ar/slag interfaces considering interfacial physical parameters: an in-situ observation study

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Inclusion engineering is a comprehensive concept dealing with the control of amount, size distribution, and chemical composition of non-metallic inclusions in advanced steels. Furthermore, it also concerns the correlation between inclusion, microstructure and property on the quality control of the final product. This work aims to summarize the research activities of the authors regarding the inclusion motion and agglomeration at the steel/gas/slag interfaces, inclusion dissolution in the slag, and fine inclusion induce intragranular acicular ferrite (IAF) nucleation in solid steels. Several aspects of interfacial phenomena, including interfacial energy, contact angle between inclusion and metals, surface tension of metals, viscosity of silicates, etc. are considered in the theoretical models to investigate the mechanism. For instance, the capillary force is found to be the main reason of inclusion agglomeration at the steel/Ar interface, the difference of interfacial energy between inclusion/ferrite and inclusion/austenite affects the nucleation barrier of IAF formation from the inclusion surface. Physical parameters are collected from either open literature as well as measurement. Last but not least, the inclusion motion behaviors at the surface of molten hydrogen plasma reduced iron is also mentioned in this work. This work aims to provide insights of the theoretical mechanism considering interfacial phenomena contributing to 'inclusion engineering'.

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