Coupled EMAG-CFD Model of Heat and Mass Transfer Processes Within an Induction Furnace Chamber With Cold Crucible

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Abstract

The aim of this study is development of a validated coupled mathematical model of metal melting in induction furnace with a cold crucible. This technology allows for melting metals and alloys which have high melting temperature like titanium alloys. It also provides effective way of impurities removal resulting in very high purities of the final product. To numerically describe phenomena that occur in the considered furnace, the mutual interaction between thermo-fluid and electromagnetic fields needs to be considered. The coupled model employed in this study involved two commercial codes Ansys Fluent and Ansys APDL and the in-house code to transfer data between the two models. As a result, the whole metal melting process was simulated. This means that multiphase model was completed with the change phase model. The coupled mathematical model was validated using advanced measurement techniques that employed high-speed cameras used to record the shape, velocity and temperature distribution of the free metal surface. In addition, to evaluate the temperature distribution on the crucible and molten metal the IR camera was applied. The results show a good agreement of the experimental and numerical results obtained for various load conditions of the furnace.

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