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Magnethohydrodynamics (MHD) analysis of the molten pool in Vacuum Arc Remelting (VAR) of Alloy 718 utilizing Gaussian distribution

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This paper conducts an analysis of the Vacuum Arc Remelting (VAR) process to manufacture steel, examining the interplay of factors such as side-arcing, arc distribution types, thermal radiation, magnetohydrodynamics (MHD), and ingot solidification. The proposed numerical model explores how these factors influence the molten metal pool profile, which is a critical aspect in ensuring the production of ingots with minimal solidification defects. Simulation results demonstrate that the diffusive arc yields a shallower melt pool compared to the constricted arc; Increased side-arcing leads to a reduction in pool depth.
Moreover, we conducted a practical experiment in a dedicated melt shop to remelt a steel electrode using the VAR process. This experiment allowed us to extract crucial data, including the pool profile, water coolant temperature, etc. In alignment with the model, we maintained consistent input parameters during the experiment, including melt rate, electric current, voltage, etc. To validate our findings, we compare the simulation result with the experimental data, aiming to improve our understanding of MHD effects within the melt pool in VAR.

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