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Enhancement of tramp elements removal from liquid iron by molten oxysulfide electrolysis

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The recycling of steel as a secondary raw material in low-carbon steelmaking is limited for maintaining sufficiently low content of tramp elements (TEs) in steel products, as TEs contaminate molten steel during the remelting process in the electric arc furnace (EAF). A molten oxide electrolysis (MOE) has been applied for metal production and new refining processes. A recently proposed electrorefining process using an oxysulfide electrolyte was shown to remove carbon and Cu simultaneously from molten iron. In this study, anodic polarization was performed at the interface between molten slag with added iron sulphide and molten iron containing typical TEs such as Cu, Sn, Ni, and Cr, and the possibility of simultaneous removal of TEs from molten iron was explored. The metal (Fe-0.5 wt%Cu-0.2 wt%Sn-0.2 wt%Ni-0.2 wt%Cr) and the slag (52.25 wt%Al2O3-23.75 wt%CaO-10.45 wt% SiO2-8.55 wt%MgO-5.00 wt%FeS) were melted at 1873 K in an Ar atmosphere with various oxygen partial pressures, and experiments under several conditions were conducted for 3600 s each. After the experiments, the metal was quenched and analyzed for Cu, Sn, Ni, and Cr concentrations using ICP-AES. In the experiments under two conditions: "constant potential electrolysis at +1.0 V vs. Mo" and "no electrolysis", the concentrations of Sn and Cr decreased from the stocking concentrations to 0.043 and 0.072 wt% for constant potential electrolysis and 0.054 and 0.087 wt% for no electrolysis, respectively. There was almost no change in the concentration of Cu and Ni. It was found that iron sulphide added molten slag enhances simultaneous removal of at least Sn and Cr by electrolysis.

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