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Evaluation of the changes in oxidic steel cleanness linked to tramp elements introduced by increased scrap recycling

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The transformation towards climate neutrality is one of the most urgent topics for steel producers and research facilities. One of the pillars to drastically reduce greenhouse gas emissions is increased recycling of steel scrap in EAFs. Unfortunately, various tramp elements are not removable from melts and accumulate over recycling cycles which often leads to scrap exports and downcycling to lower steel qualities.
Different influences of tramp elements on material properties and processes such as hot-shortness or shifting of transformation points are already well known. However, the interplay of tramp elements and non-metallic inclusions (NMIs) remains mostly unresearched. The chemistry modification due to introduction of these elements leads to altered surface tension and wetting behavior, which alters nucleation and separation of NMIs. Furthermore, possible agglomerations of tramp elements around NMIs can affect the deformation behavior of the particles.
In this study, medium-carbon steels were modified by alloying with the tramp elements copper, molybdenum, tin, and nickel. The alloys were investigated using drop shape analysis, quenching and deformation dilatometry as well as scanning electron microscopy to investigate possible effects of tramp elements on the steel matrix and NMIs and to contribute to a more thorough understanding of the interaction between them.

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