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Investigation of microscopic non-metallic inclusions in powder metallurgical high-speed steels

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The production of high-speed steels using powder metallurgy (PM) frequently results in materials with superior characteristics in terms of wear resistance and mechanical properties. This is particularly the case when compared to conventionally produced steels. Cleanness is thereby a critical factor that influences the property profile of these steels. For this reason, non-metallic inclusions (NMI) are increasingly becoming the focus of product and process optimization investigations. Even if macroscopic inclusions usually induce material failure, understanding the microscopic cleanness is essential for evaluating inclusion behavior during processing. Various methods are used in industry and research to assert the characteristics of steel cleanness, such as the composition, distribution, size and morphology of the inclusions.
The present work analyzes the micro cleanness of different powder metallurgical high-speed steels in detail. For this purpose, several samples were examined using automatic and manual scanning electron microscopy (SEM) combined with energy-dispersive X-ray spectroscopy (EDS) measurements. The measured data was then subjected to further analytical and statistical analysis, e.g., to predict the maximum inclusion size by applying the GPD (Generalized Pareto Distribution) method. The results regarding the inclusions' size, distribution and chemical composition were classified and compared. The obtained data is essential for describing reactions and interactions in the steel-slag-refractory system and allows a possible link to thermodynamic and kinetic considerations. This combination of different tools and methods enables a valuable and representative description of inclusion behavior in the investigated steels and helps to identify further optimization potentials.

Speaker Country

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