A COMPUTATIONAL AND EXPERIMENTAL APPROACH TO UNDERSTANDING THE HOMOGENIZATION BEHAVIOUR OF ALLOYING ELEMENTS DURING THE SINTERING OF PM STEEL

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ABSTRACT

By combining thermodynamic software (Thermo-Calc and DICTRA), sintering experiments and electron microscopy techniques, a deeper understanding into the homogenization behaviour of alloying elements within ferrous PM steel during sintering was made. DICTRA simulations provided 1-D insight into the evolution of concentration profiles over various sintering times for master alloy systems involving Cr, Mn, C and Fe. All master alloys were attached to an Fe or Fe C particle. Electron microscopy analyses were conducted on an industry-produced automotive component that was sectioned and sintered industrially as well as experimentally at 1280°C for 30 minutes and 13.4 hours. DICTRA simulation results of single alloying element sources were studied alongside multiple alloying element source profiles obtained by compiling point quantification from wavelength dispersive spectroscopy maps for the sintered automotive component. Computational results also provided semi-quantitative recommendations on optimal master alloy forms that lead to an improvement in homogenization.

INTRODUCTION

With an emphasis on lean powder metal component production, several studies have been made to investigate the most efficient use of each and every alloying element addition in PM (powder metallurgy) steels. Such efforts include optimizing final product chemical homogeneity which can enhance overall mechanical properties [1]. A variety of approaches have been tried to improve overall chemical homogeneity of alloying elements in PM steels as they undergo sintering, some of which include altering