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Early precipitation behavior of secondary carbides in medium carbon low alloyed tool steel studied by in-situ polarized small-angle scattering and precipitation modelling

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Abstract

The strength of tempered martensite in low alloyed tool steel depends on the precipitation of secondary carbides. Tempering parameters such as time and temperature together with heating rate to tempering temperature will influence the precipitation sequence and these critical process parameters must be controlled to achieve ultimate precipitation strengthening. In this work precipitation was studied in a low alloyed tool steel using in-situ polarized small angle scattering (SANSPOL) during heating and isothermal holding. It was possible with SANSPOL to study the initial precipitation of secondary Mo- and V-rich carbides. It was found that Mo- and V-rich carbides form above 500 °C, simultaneously to the formation of cementite, which started to form already at lower temperature. It was furthermore found that the cementite particles can be described as having a core-shell structure, the Mo-V-rich carbides small and were approximated as spherical. Precipitation simulations performed using TC-PRSIMA were finally performed to compare with the experimental results, and the simulations were found to describe the experimental results well.