

Quantitative X-ray Diffraction Study of Welded Joints in Heat-resistant Steels

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Welding of cast heat-resistant steels have attracted much attention because of their interesting high-temperature applications in the metallurgical and mining industry. However, welded joints in service at elevated temperatures can yield precipitation of intermediate complex phases such as sigma, chi and carbides. In order to compare the behavior of the material with its microstructural features, a quantitative characterization of the weldments was carried out by means of X-ray diffraction. For this purpose Rietveld analysis were performed on a series of arc-welded joints of heat-resistant steels of the HC (25Cr-3Ni) and HD (30Cr-6Ni) type.

The Rietveld refinements were performed based upon typical measurement and global parameters. The powder diffraction patterns of the weldments resulted in strong preferred orientation effects due to the uniaxial solidification of the weld metal-pool, which was corrected in the Rietveld refinement by using the March-Dollase function. The pseudo-Voigt function was used for the simulation of the peak shapes, while the background was modeled by a 3rd order polynomial in 2θ with refinable coefficients.

A total of five phases were identified and considered in the refinemet process, namely ferrite (Cr,Ni), austenite (Ni,Cr), sigma phase, Cr_{23}C_6 and Cr_7C_3 .

The main advantage of this processing was the use of the March-Dollase model for correction of the strong texture effects on the diffraction pattern of the weldments, which yield the lower R-values.

Keywords: Rietveld refinemet, welding , heat-resistant steels