Reducing the Effects of Texture on Phase Fraction Measurements of Retained Austenite in Sheet Steels Using a Hex-Grid Sampling Scheme

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X-ray diffraction is a common method of measuring retained austenite volume fraction of multi-phase steels and phase fractions in other materials. However, current standards for measuring retained austenite phase fraction using XRD (ASTM E975) require a near random crystallographic texture. A XRD-based method to accurately measure phase fractions in textured materials such as sheet steels has yet to be developed. Previous work has indicated that a "hex-grid" sampling scheme can largely eliminate the effects of texture on phase fraction measurements. However, the transmission-based complete pole figure measurement modeled previously is impractical for industrial applications.

In the current study, the hex-grid scheme was simulated to permit reflection based measurements. Two hex-grid methods were applied, with low data-count grid-spacings to minimize time and motor motion. The first method simulates results using a sample with the sample and sheet normal directions coincident, with other sample surfaces orthogonal to the rolling and transverse directions of the sheet. The second method simulates results when a "cube corner" sample has been constructed from the material, where the sample normal is 54.7° from the normal, transverse, and rolling directions. In this type of sample each of these orientations would be reachable by reflection based XRD equipment.

This presentation will compare the accuracies of the hex-grid method of phase fraction measurement based upon the grid-spacing and sample geometry used. When using more than two XRD peaks in the austenite calculation, iterations of the hex-grid method with grid spacing of 20.5º or less produced measurements within 5% relative to the actual phase fraction for realistic texture parameters of cold rolled and heat treated multiphase sheet steels. The results assuming a "cube corner" sample geometry retained this accuracy at much larger texture index values. In general, the hex-grid method is shown to be a practical tool for reducing scatter in phase fraction measurements of textured materials.