Application of Advanced EBSD Methods for Phase Detection in Martensitic Steels

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Abstract

Steel microstructures are often complex, can contain multiple phases, and require analyses from multiple characterization techniques combined in order to adequately determine the constituent microstructure and properties. Electron backscattered diffraction (EBSD) is a particularly useful technique as it can rapidly identify phase and grain orientation in a single scan. Difficulties arise, however, when the size of the features being studied are close to the size of the interaction volume of the incident electron beam. Here we used emerging EBSD techniques, namely non-local means pattern averaging reindexing (NLPAR), combined with the so-called pattern matching or dictionary indexing (DI) methods in order to determine the phase fraction of retained austenite in a 10 wt% Ni steel. The steel undergoes a quench, lamellarization, and tempering (QLT) heat treatment, which produces a structural material with high strength and good toughness. The QLT heat treatment also produces a microstructure with thin films and grains of retained austenite on the order of 100s of nm in size decorating the boundaries of the martensite phase. This results in a complicated microstructure with small austenite regions that are difficult to measure using conventional EBSD techniques. Here we show that through combining NLPAR and DI that we can obtain consistent phase fraction measurements of retained austenite in these complex steel microstructures.

Keywords: EBSD, TKD, steel, microstructure, martensite, austenite

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