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Technical Note Growth of Austenite in Cold-Rolled Tempered Martensite

by A. E. Nehrenberg

IN an earlier publication¹ it was shown that the I shape assumed by a volume of growing austenite is inherited from the prior structure. The matrix grains of pearlitic microstructures are equiaxed, and austenite grows in an equiaxed manner in these prior structures. Martensite and bainite, on the other hand, have an acicular grain structure, and the austenite produced in such structures grows in an acicular manner.

In the discussion of this paper² it was pointed out that in cold-rolled tempered martensite, austenite grows in an equiaxed, rather than an acicular manner. The results of an experiment carried out to arrive at an understanding of this behavior are illustrated by the micrographs.

Fig. 1 shows the acicular microstructure produced by heating tempered martensite to a temperature within the Ac1-Ac3 range, 1350°F. When tempered martensite is cold rolled, then heated to the same temperature, the equiaxed structure shown in Fig. 2 is produced. A sample of cold-rolled tempered martensite heated at 1350°F just long enough for the formation of a small amount of austenite is shown by Fig. 3 to have an equiaxed (recrystallized) ferrite grain structure. The small particles of austenite which formed at 1350°F in the equiaxed ferrite matrix are likewise equiaxed.

Thus, the equiaxed growth of austenite in cold-worked tempered martensite is not a contradiction of the principles described in the previous paper, for the growth pattern reflects the matrix grain structure existing at the time of austenite formation.

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Figs. 1 to 3—Effect of cold rolling on growth pattern of austenite in tempered martensite. X2000.

Fig. 1—Tempered martensite heated ½ hr at 1350°F, quenched, and tempered ½ hr at 600°F.

Dark etching structure (tempered martensite) was austenite at time of quench. 2 pct Zephiran chloride-pical etch.

Fig. 2—Tempered martensite cold rolled 50 pct, then heat treated in the same manner as Fig. 1.

Etch same as Fig. 1.

Fig. 3—Tempered martensite cold rolled 50 pct and heated 2 min total time in lead at 1350°F, quenched, and tempered ½ hr at 600°F.

Nominal composition of steel used was: 0.25 pct C, 1.3 pct Mn, 1.5 pct Si, 1.8 pct Ni, and 0.40 pct Mo. Etched in Ailten's reagent.