Pergamon

Scripta Materialia, Vol. 34, No. 5, pp. 771-773, 1996
Elsevier Science Ltd

1359-6462/96 $12.00 + .00

0956-716X(95)00576-5

COMMENT ON "INFLUENCE OF AUSTENITE GRAIN SIZE ON $\gamma \rightarrow \varepsilon$ MARTENSITIC TRANSFORMATION TEMPERATURE IN Fe-Mn-Si-Cr ALLOYS"

B.H. Jiang, Xuan Qi, Weiming Zhou, and T.Y. Hsu (Xu Zuyao)
Department of Materials Science, Shanghai Jiao Tong University,
Shanghai 200030, China

(Received August 11, 1995)
(Revised September 14, 1995)

In our previous paper published earlier in this journal (1), the results of M_s temperature measured by a dilatometry, are not the real M_s of $\gamma \rightarrow \varepsilon$ martensitic transformation, but the temperature of the $\gamma \rightarrow \alpha$ transformation created by a demanganization layer at the surface of specimen, which are identified by our latest experimental results.

The specimen for X-ray diffraction taken from a hot-rolled sheet of alloy (Fe-26.4wt%Mn-6.2wt%Si-5.2wt%Cr) were removed about 0.06 mm in surface by grinding and chemical polishing before austenization and the X-ray spectrum revealed a principle phase of γ and a small amount of ε phase, as shown in Fig. 1(a). After austenitization followed by quenching (no matter how the specimens were protected in a vacuum or in an Ar atmosphere during heating) a strong α (110) reflection appears in the X-ray spectrum, sometimes even hides the reflection of γ and ε phase, as shown in Fig. 1(b). After removing the surface layer by 0.02, 0.04 and 0.06 mm respectively, the intensity of α reflection decreases until it disappears, and that of γ and ε phase increases as shown in Fig. 1(c). The composition analysis on surface of the specimen indicates that the content of Mn after quenching is less than one half of that after removing the surface layer by 0.06 mm. Therefore, it can be considered that for Fe-Mn-Si based alloys containing higher contents of Mn, a demanganization layer at surface of specimen will inevitably exist affecting the measurement of M_s by dilatometry. The typical dilatation curve for the specimen directly quenched from austenitizing temperature is shown in Fig. 2(a), from which we can see a dilatational transition in cooling part. However for the specimen after removing the demanganization layer by grinding and chemical polishing, a contracted transition in cooling curve is visible as shown in Fig. 2(b). The results of lattice parameter measurements of γ (fcc) phase and ε (hcp) phase are a = 0.3599 nm, and c = 0.4130 nm, a = 0.2547 nm respectively, from which the variation of volume per unit cell of these two phases in this Fe-Mn-Si-Cr alloy is estimated; it is noted that the fcc-hcp transformation is accompanied by a volume contraction about 0.61%. Obviously, the M_s temperature determined from the dilatation curve in Fig. 2(b) is of the $\gamma \rightarrow \varepsilon$ transformation, but the transition temperature determined from the curve in Fig. 2(a) is actually the $\gamma \rightarrow \alpha$ transformation, which is usually accompanied by an expansion in volume.

Thus the dilatational experiments of the alloy were reexamined. The surface layer of all the dilatational specimens were removed by 0.06 mm by grinding and chemical polishing. The M_s temperature

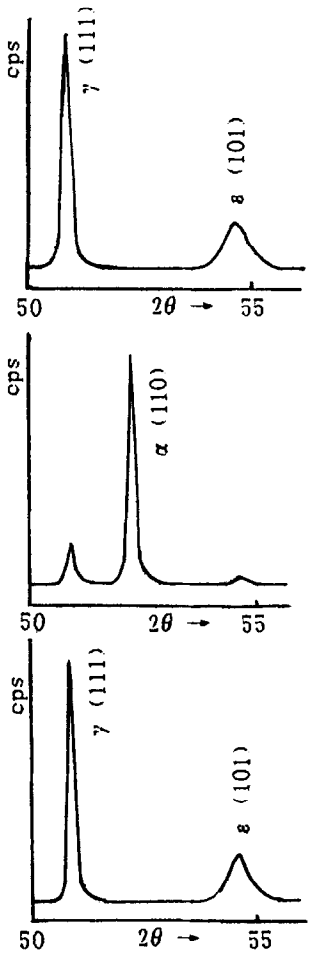

Figure 1. X-ray diffraction spectrum (a) as hot rolled state after removing surface layer by 0.06 mm. (b) as quenched from austenitizing temperature. (c) after removing the demanganization layer by 0.06 mm after quenching.

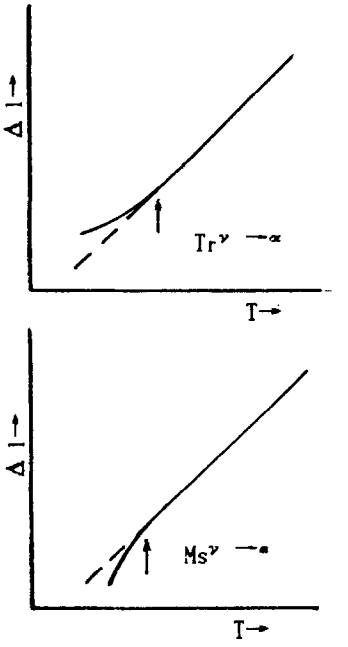

Figure 2. Schematic plot of the dilatometry (a) as quenched from austenitizing temperature (b) after removing the demanganization layer after quenching.

determined from the dilatational curves for various austenitizing temperatures from 1073k to 1273k are listed in Table 1.

From above results, it is clear that the grain size of austenite has no marked influence on the M_s of $\gamma \rightarrow \varepsilon$ martensitic transformation in the tested range of the grain size, which is consistent with the results in the Co-14Ni alloy with a low SFE (2). The reason may be that in alloys with lower stacking fault energy, the nucleation of ε-martensite occurs by means of the preexisted stacking faults (3) rather than through the pole mechanism (4). Further verification on the relationship between the probability of stacking fault and the grain size of γ phase determined by X-ray diffraction will be published later.

TABLE 1
M_s of $\gamma \rightarrow \varepsilon$ for Various Austenitizing Temperatures

Austenitizing temper. (k)	1073	1123	1173	1223	1273
mean grain size of γ (μm)	20.62	23.70	28.30	34.58	37.12
M_s temper. (k)	307	311	311	313	313

References

1. B. H. Jiang, Limin Sun, Ruchun Li and T.Y. Hsu (Xu Zuyao), Sci. Metall. Mater., 33, 63 (1995).
2. T. Y. Hsu (Xu Zuyao) and Lu Minjiong, Scientific Research Paper of Shanghai Jiao Tong University, NO. 80218, (1966).
3. T. Y. Hsu (Xu Zuyao), Acta Metall. Sinica, 16, 430 (1980).
4. A. Seeger, Z. Metallk., 47, 653 (1956).