

CHAPTER 5

THEORY OF THE ALPHA TO EPSILON TRANSFORMATION

In this chapter shock wave measurements on iron and metallurgical data on martensitic transformations are brought together in an attempt to produce a plausible description of the iron transformation.

5.1. Review of Experimental Information

The alpha to epsilon transformation in iron has been studied by several different investigators using different experimental techniques and varying different parameters. Salient results of these studies are summarized here.

5.1.1. Shock Experiments

Stress in the plastic I shock is a measure of the transformation stress, P^{TL} , for the compression or loading process. Some measurements of P^{TL} for 19- to 25-mm-thick iron samples are given in Table 5.1. Iron samples used have had different metallurgical histories and probably contained different trace amounts of impurities. Agreement among values of P^{TL} in Table 5.1 implies that trace amounts of impurities and different metallurgical histories do not affect P^{TL} significantly. Minshall²² has shown that work hardening and heat treating Armco iron slightly increases P^{TL} , but the transition volume remained

TABLE 5.1.--Iron transformation stress

Source	p^{TL} (kbar)
Bancroft, <u>et al.</u> (REF. 2)	131
Minshall (REF. 22)	132
Loree, <u>et al.</u> (REF. 44)	129 ± 1
Barker and Hollenbach (REF. 15)	130 ± 1
Present study	131 ± 3