From Figure 1, two different types of habit planes were observed at 90 kb. Five habits were approximately $(\bar{1}\bar{1}2)_\gamma$, and only one was near the $(\bar{2}\bar{2}5)_\gamma$. At 150 kb., for the variant of the orientation relationship used, the habit plane was always found to be near to $(\bar{1}\bar{1}2)_\gamma$.

The position of the habit plane depends on the choice of inhomogeneous shear system and the values of the lattice parameters. The inhomogeneous shear system whose habit plane is the $(\bar{1}\bar{1}2)\gamma$ has been found to be the $(111)_\gamma[\bar{1}2\bar{1}]_\gamma$, while the shear system of the habit plane $(\bar{2}\bar{2}5)_\gamma$ is the $(110)_\gamma[1\bar{1}0]_\gamma$. The set of traces analyzed failed to define a specific habit plane. This scatter may be due to the poorly resolved γ plates. A real variation due to varying lattice parameters however, cannot be ruled out. In determining the dilation parameter δ, we note that the $(111)\gamma[\bar{1}2\bar{1}]_\gamma$ traces tended to be closer to zero dilation which is necessary for a transformation induced by a compressive shock front.

The shear system of the $(\bar{1}\bar{1}2)_\gamma$ habit involves a shear on the $(101)_\alpha$ which is 80° from the habit plane of zero dilation. The γ plates observed at 90 kb were internally twinned on the $\{111\}_\gamma$. The $\{111\}_\gamma$ twinning plane was always found to be at an angle of 80-90° to the habit plane. We conclude that the internal twins are not deformation twins but are a result of the inhomogeneous shear in the α' to γ transformation. The internal twins further indicate that the transformation occurred through a shear system of the type $(111)_\gamma[\bar{1}2\bar{1}]_\gamma$.

The untransformed α-martensite showed the typical structure of cold worked metals. On transforming, no preferrential nucleation sites were observed. Since γ bands were found with deformation twins, it is believed that there is some relationship between the nucleation of twins and γ plates.

In the Fe-14 Mn alloy, single α' plates as opposed to a twin related pair were observed in specimens shock loaded at 90 and 150 kb. These single plates may be due to the $\alpha\rightarrow\varepsilon\rightarrow\alpha'$ transformation. In explaining these observations one must consider the orientation relationships between γ, ε and α. The orientation relationship is[9,10]

$$(111)_\gamma \;||\; (0001)_\varepsilon \;||\; (101)_\alpha$$
$$[110]_\gamma \;||\; [1210]_\varepsilon \;||\; [111]_\alpha$$

with the standard viriant of the KS relationship. The convention of BCC α to HCP ε requires an invariant plane strain on $\{112\}_\alpha$ together with a dilation (δ) of about 1.5%. The dilation is in the form of a small uniform expansion[11]. However, under a compressive shock wave, the dilation is not energetically favorable, and any transformation that does take place must have $\delta \approx 0$. In terms of microscopy, the α plates are single plates, since as δ approaches zero from its maximum value, the habit planes for a twin related pair diverge.

Acknowledgements

The author is grateful to Prof. N. Brown for his interest in the problem.

References

1. R. S. Davies, in Iron and its Dilute Solid Solutions, Interscience, 1963 p.61.
2. P. G. Johnson, B. A. Stein and R. S. Davies, J. Appl. Phys. 33, 557 (1962).
3. D. Bancroft, E. L. Peterson, and S. Minshall, J. Appl. Phys. 27, 291 (1956).
4. J. C. Jamieson, A. W. Lawson, J. Appl. Phys. 33 , 776 (1962).
5. T. Takahashi and W. A. Bassett, Science 145, No. 3631 (1964).
6. G. E. Duval and G. R. Fowles, High Pressure Physics and Chemistry, Academic Press, 1963 Vol. 2, p. 69.
7. J. Dash, Phd. Theses, University of Pennsylvania (1966).
8. H. G. Bowden and P. M. Kelly, Acta Met. 15, 1489 (1967).
9. P. M. Kelly, Acta Met. 13, 635 (1965).
10. J. A. Venables, Phil. Mag. 7, 35 (1962).
11. W. G. Burgers, Physica I, 561 (1934).