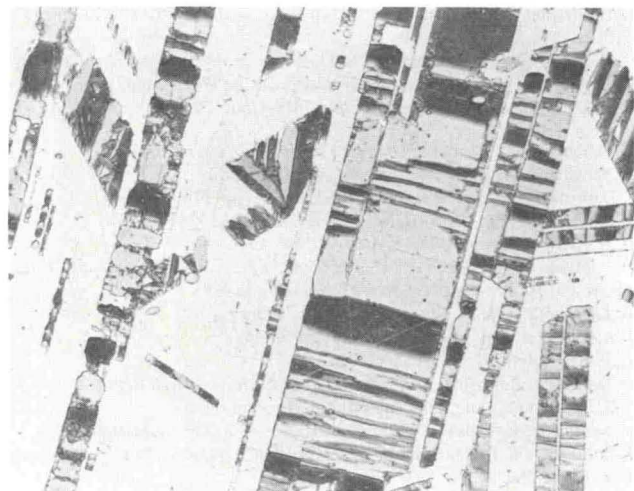
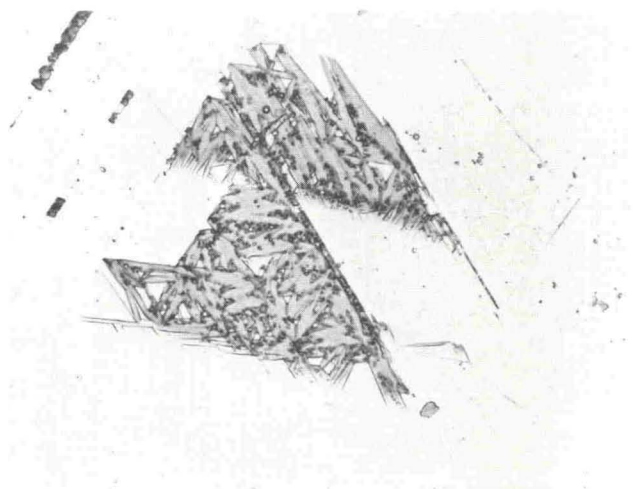


served and should form at a lower pressure than the hcp phase. To determine the accuracy of this hypothesis, a sample of annealed Fe-11.6 pct Ni-17.4 pct Cr was metallographically polished, X-rayed, and subjected to a series of pressurizations ranging from 7.5 to 25.5 kbar in 2.5 kbar intervals. Between each



(a)



(b)

Fig. 8—Fe-11.6 pct Ni-17.4 pct Cr alloy subjected to 25.5 kbar. The figures show the two different structures found in the sample. (a) Magnification 740 times, (b) magnification 740 times.

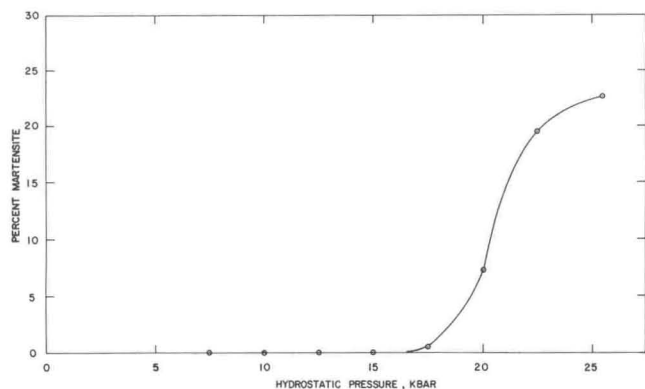


Fig. 9—Percent martensite as a function of hydrostatic pressure for Fe-11.6 pct Ni-17.4 pct Cr.

pressurization, the sample was X-rayed and observed microscopically. The sample was photographed when required for quantitative light metallography. Fig. 9 is a plot of the percentage of martensite in the sample vs the hydrostatic pressure. The data point at 17.5 kbar is based on a visual microscope estimate while those at 20.0, 22.5, and 25.5 kbar are based on quantitative light metallography. It was found that X-ray determination of the percentage of phases present was not accurate enough to be used because of a preferred orientation in the fcc parent phase that led to a preferred orientation in the hcp and bcc transformation products. X-ray diffraction of the samples revealed that no bcc martensite formed prior to the formation of the hcp martensite and that the amount of bcc structure formed was equal to approximately one-third the amount of hcp. From these observations, it appears that under purely hydrostatic stress the fcc phase transforms simultaneously into hcp and bcc martensite in an abaric manner.

Two other observations were made regarding the nature of these transformations. First, microprobe analysis indicated no composition difference between the matrix and the transformation product. This is another prerequisite for a martensitic transformation. Second, it was found that the hcp martensite was metastable at ambient conditions. On heating to a temperature as low as 100°C, all of the hcp phase present transformed to the fcc phase. At these temperatures, the amount of bcc martensite remained constant.

The high-pressure transformation experiments undertaken in Fe-Ni-Cr alloys during this study have shown that the bcc → hcp, fcc → hcp, and hcp → bcc transformation pressures are composition-dependent and that the transformation is martensitic in nature.

CONCLUSIONS

X-ray diffraction and light metallographic examinations of phase transformations induced in iron-rich Fe-Mn and Fe-Ni-Cr alloys by means of high pressure showed that:

1) Alloy additions of manganese and of nickel plus chromium significantly reduce the formation pressure of the hcp phase and can in some cases stabilize the phase enough to prevent it from transforming into some other phase during pressure release.

2) All of the transformations are martensitic, as demonstrated by the following observations:

a) The transformation pressures do not represent equilibrium pressures because a hysteresis exists, *i. e.*, there is a difference between the forward and reverse transformation pressures.

b) The extent of the transformation is a function of the difference between the applied pressure and the pressure at which the phase first forms and is not a function of time at the applied pressure.

c) There is no difference in composition between the matrix and the transformation product.

d) Surface relief was observed on samples polished prior to pressurization.

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