TABLE II. Density changes in shock deformed Fe-Mn alloys.

Alloy	Heat treatment	Initial density ρ_0 (g/cm^3) at 20 °C	Density changes[a] 90 kbar	150 kbar	300 kbar	500 kbar
Fe	900 °C, water quench	7.8711	1.0001	1.0002	1.0002	1.0002
Fe-0.4Mn	900 °C, water quench	7.8716	1.0002	1.0002	1.0003	1.0003
Fe-4Mn	950 °C, water quench	7.8698	1.0023	1.0097	1.0146	1.0140
Fe-7Mn	950 °C, water quench	7.9088	1.0028	1.0028	1.0218	1.0431
Fe-14Mn	950 °C, water quench	7.9902	1.0275	1.0392	1.0449	1.0450
Fe	900 °C, furnace cool	7.8712	1.0001	1.0002	1.0002	1.0002
Fe-0.4Mn	900 °C, furnace cool	7.8719	1.0002	1.0002	1.0002	1.0003
Fe-4Mn	950 °C, furnace cool	7.8722	1.0002	1.0006	1.0007	1.0007
Fe-7Mn	950 °C, furnace cool	7.9135	1.0003	1.0006	1.0007	1.0008
Fe-14Mn	950 °C, furnace cool	7.9939	1.0008	1.0008	1.0009	1.0009

[a]Density change = density after shock loading (ρ_s)/unshocked density (ρ_0).

produced close-packed phases was exhibited by quenching them to 78 °K and causing only a slight change in the density ratio (less than 0.15%). It is emphasized that the retained close-packed phase which was produced by shock primarily came from the bcc martensite with manganese content in the range of 4-16 wt%. The retained high-pressure phase increased with the manganese content of the bcc phase. The slow-cooled alloys contained bcc martensite with 2–4 wt% Mn, and, consequently, the retainment of the high-pressure phase was not possible.

B. Structure Determination

X-ray diffraction data of all alloys were taken before and after shocking at 90, 150, and 300 kbar. The x-ray diffraction results indicate that, for the Fe-4Mn and Fe-7Mn alloys, the γ phase has been stabilized at room temperature after shock deformation, while the ϵ phase has been stabilized for the Fe-14Mn alloy. The unshocked quenched Fe, Fe-0.4Mn, and Fe-4Mn specimens produced the diffraction lines of bcc Fe-Mn; equilibrium bcc and martensitic bcc lines were not separable. The α' lattice parameter was found to increase linearly with increasing solute content up to 14 wt% Mn. The unshocked quenched Fe-7Mn and Fe-14Mn specimens produced the diffraction lines of bcc martensite. The quenched and shocked Fe and Fe-0.4Mn specimens showed the same lines as the unshocked specimens. However,

TABLE III. X-ray diffraction data of Fe-Mn shock loaded up to 300 kbar.

P (kbar)	d(bcc) (Å)	$(hkl)_{bcc}$	a(bcc) (Å)	d(hcp) (Å)	$(hkl)_{hcp}$	a(hcp) (Å)	c(hcp) (Å)	d(fcc) (Å)	$(hkl)_{fcc}$	a(fcc) (Å)
Fe-14Mn										
unshocked	2.05 ± 0.05	(110)	2.85							
	1.40 ± 0.05	(200)								
	1.20 ± 0.03	(211)								
150	$\sim 2.04 \pm 0.05$	(110)	2.83	1.90 ± 0.05	(101)	2.45	3.95			
	1.40 ± 0.08	(200)		$\sim 2.00 \pm 0.06$	(002)					
	$\sim 1.19 \pm 0.05$	(211)								
300	$\sim 2.04 \pm 0.05$	(110)	2.83	2.14 ± 0.06	(100)	2.45	3.95			
	1.40 ± 0.05	(200)		$\sim 2.00 \pm 0.08$	(002)					
	1.17 ± 0.07	(211)		$\sim 1.90 \pm 0.08$	(101)					
				1.45 ± 0.05	(102)					
				1.25 ± 0.07	(110)					
				1.15 ± 0.07	(103)					
Fe-7Mn										
unshocked	$\sim 2.00 \pm 0.02$	(110)	2.80							
	1.38 ± 0.02	(200)								
	1.21 ± 0.03	(211)								
300	$\sim 2.00 \pm 0.05$	(110)	2.80					2.06 ± 0.05	(111)	~ 3.50
[Fe-7Mn]	1.40 ± 0.06	(200)						1.80 ± 0.05	(200)	~ 3.50
	1.20 ± 0.05	(211)						1.30 ± 0.05	(220)	~ 3.47
Fe-4Mn										
unshocked	$\sim 1.98 \pm 0.05$	(110)	2.79							
	1.38 ± 0.02	(200)								
	1.20 ± 0.03	(211)								
300								2.05 ± 0.05	(111)	~ 3.50
								1.79 ± 0.05	(200)	~ 3.49
								1.32 ± 0.05	(220)	~ 3.48