

Supplementary material for:

Experimental study of high temperature phase equilibria in the iron-rich part of the Fe-P and Fe-C-P systems

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Table S-I: Detailed chemical analysis of investigated samples and phase transformation temperatures below 1000 °C; Fe-P, Fe-C-0.1%P, Fe-0.20%C-P

Alloy	Fe wt%	C wt%	Si wt%	Mn wt%	P wt%	S wt%	Al wt%	N wt%	Curie [°C]	Std. Dev. [°C]	Typ. Err. [°C]	γ -Form. [°C]	Std. Dev. [°C]	Typ. Err. [°C]	α -End [°C]	Std. Dev. [°C]	Typ. Err. [°C]
A-I	99.9085	0.008	0.002	0.014	0.026	0.0034	0.012	0.0021	765.9	0.3	2	n.m.	-	-	924.4	0.3	5
A-II	99.9009	0.006	0.002	0.015	0.044	0.0032	0.002	0.0028	765.2	0.6	2	n.m.	-	-	937.0	2.3	5
A-III	99.8304	0.008	0.002	0.013	0.102	0.0033	0.015	0.0025	763.8	0.1	2	n.m.	-	-	958.2	0.7	5
A-IV	99.7456	0.008	0.0025	0.021	0.147	0.0036	0.037	0.0021	767.0	0	2	n.m.	-	-	999.4	0.1	5
A-V	99.616	0.006	0.003	0.014	0.322	0.0033	0.01	0.0021	757.2	0.1	2	n.m.	-	-	n.p.	-	-
A-VI	99.46625	0.008	0.004	0.031	0.419	0.0034	0.032	0.00225	758.5	0.1	2	n.m.	-	-	n.p.	-	-
A-VII	99.4396	0.008	0.003	0.016	0.480	0.0036	0.022	0.0025	756.9	0.1	2	n.m.	-	-	n.p.	-	-
A-VIII	99.2616	0.007	0.003	0.015	0.660	0.0036	0.023	0.0024	751.8	0.4	2	n.m.	-	-	n.p.	-	-
A-IX	99.2345	0.007	0.002	0.016	0.700	0.0032	0.007	0.0083	751.6	0.1	2	n.p.	-	-	n.p.	-	-
A-X	98.89275	0.008	0.0055	0.0515	0.970	0.0035	0.031	0.00215	742.7	0.2	2	n.p.	-	-	n.p.	-	-
A-XI	98.7513	0.008	0.002	0.016	1.180	0.0035	0.01	0.0075	738.5	0.3	2	n.p.	-	-	n.p.	-	-
A-XII	97.9618	0.004	0.004	0.012	1.980	0.0033	0.009	0.0026	720.1	0	2	n.p.	-	-	n.p.	-	-
A-XIII	97.6286	0.009	0.002	0.016	2.300	0.0033	0.015	0.0054	721.5	0.8	2	n.p.	-	-	n.p.	-	-
A-XIV	96.2174	0.011	0.002	0.015	3.700	0.0033	0.028	0.0048	745.9	0.9	2	n.p.	-	-	n.p.	-	-
A-XV	94.0626	0.008	0.001	0.014	5.870	0.0034	0.012	0.0114	748.6	0	2	n.p.	-	-	n.p.	-	-
A-XVI	93.4959	0.017	n.m.	n.m.	6.480	0.0046	n.m.	0.0025	748.5	0	2	n.p.	-	-	n.p.	-	-
A-XVII	92.4061	0.017	n.m.	n.m.	7.570	0.0051	n.m.	0.0018	748.5	0.2	2	n.p.	-	-	n.p.	-	-
A-XVIII	90.8953	0.017	n.m.	n.m.	9.080	0.0055	n.m.	0.0022	748.6	0.1	2	n.p.	-	-	n.p.	-	-
B-I	99.7881	0.004	0.014	0.058	0.107	0.0046	0.003	0.0019	766.2	0.9	2	n.p.	-	5	966.5	3.5	5
B-II	99.7572	0.033	0.014	0.06	0.106	0.0045	0.003	0.0023	765.6	0.1	2	733.2	0.4	5	929.1	0.1	5
B-III	99.7179	0.059	0.015	0.064	0.108	0.0051	0.008	0.002	763.2	0.3	2	731.9	0.7	5	911.7	1	5
B-IV	99.6626	0.099	0.014	0.06	0.110	0.0044	0.003	0.029	765.1	0.3	2	733.5	0.1	5	n.m.	-	-
B-V	99.6862	0.096	0.018	0.068	0.101	0.0052	0.004	0.0016	764.5	0	2	734.3	0	5	n.m.	-	-
B-VI	99.6511	0.136	0.015	0.057	0.105	0.0045	0.012	0.0014	765.7	0.2	2	738.4	1.8	5	n.m.	-	-

Table S-I (continued)

Alloy	Fe wt%	C wt%	Si wt%	Mn wt%	P wt%	S wt%	Al wt%	N wt%	Curie [°C]	Std. Dev. [°C]	Typ. Err. [°C]	γ -Form. [°C]	Std. Dev. [°C]	Typ. Err. [°C]	α -End [°C]	Std. Dev. [°C]	Typ. Err. [°C]
B-VII	99.5924	0.203	0.013	0.059	0.106	0.0043	0.003	0.0013	766.1	0.3	2	732.8	0	5	n.m.	-	-
B-VIII	97.5497	0.296	0.014	0.06	0.110	0.0046	0.006	0.0007	765.2	0.2	2	732.0	0.1	5	n.m.	-	-
B-IX	99.4059	0.378	0.014	0.063	0.106	0.0047	0.007	0.0014	n.m.	-	2	735.0	0	5	n.m.	-	-
B-X	99.1619	0.690	0.001	0.015	0.099	0.0031	0.004	0.003	n.m.	-	2	729.2	0.1	5	n.m.	-	-
B-XI	98.8457	1.000	0.001	0.015	0.099	0.0033	0.01	0.003	n.m.	-	2	729.9	0.4	5	n.m.	-	-
B-XII	98.4577	1.380	0.001	0.017	0.101	0.0033	0.014	0.003	n.m.	-	2	733.4	0.9	5	n.m.	-	-
C-I	99.6433	0.206	0.017	0.068	0.057	0.0049	0.002	0.0018	765.9	0	2	730.7	0.1	5	n.m.	-	-
C-II	99.6044	0.199	0.017	0.068	0.103	0.0047	0.002	0.0019	766.0	0.1	2	731.4	0.1	5	n.m.	-	-
C-III	99.5436	0.203	0.017	0.07	0.158	0.0046	0.002	0.0018	764.4	0.1	2	733.4	0.1	5	n.m.	-	-

Table S-II: High temperature phase transformation temperatures of investigated samples higher 1000 °C; Fe-P, Fe-C-0.1%P, Fe-0.20%C-P

Alloy	δ -Form. [°C]	Std. Dev. [°C]	Typ. Err. [°C]	γ -End [°C]	Std. Dev. [°C]	Typ. Err. [°C]	L-Form. [°C]	Std. Dev. [°C]	Typ. Err. [°C]	Liquidus [°C]	Std. Dev. [°C]	Typ. Error [°C]	Phase transf.
A-I	1389.4	1.5	5	1400.3	1.5	10	1527.5	0.4	2	1535.1	0	2	left of cA
A-II	1377.7	0.7	5	1385.9	0.6	10	1523.8	0.1	2	1534.9	0	2	left of cA
A-III	1367.7	1.1	5	1380.8	1.5	10	1513.3	1	2	1532.4	0.1	2	left of cA
A-IV	1341.9	0.8	5	1359.0	0	10	1504.7	1.9	2	1529.1	0	2	left of cA
A-V	n.p.	-	-	1320.2	1	10	1474.6	0.3	2	1525.3	0.2	2	-
A-VI	n.p.	-	-	1272.4	0	10	1454.0	0.4	2	1520.5	0	2	-
A-VII	n.p.	-	-	n.m.	-	-	1450.7	0.3	2	1520.9	0.3	2	-
A-VIII	n.m.	-	-	n.p.	-	-	1420.2	0.1	2	1515.0	0	2	-
A-IX	n.p.	-	-	n.p.	-	-	1407.6	1.2	2	1512.8	0	2	-
A-X	n.p.	-	-	n.p.	-	-	1348.9	0.1	2	1502.6	0.1	2	-
A-XI	n.p.	-	-	n.p.	-	-	1321.5	0.7	2	1497.1	0.3	2	-

Table S-II: (continued)

Alloy	δ -Form. [°C]	Std. Dev. [°C]	Typ. Err. [°C]	γ -End [°C]	Std. Dev. [°C]	Typ. Err. [°C]	L-Form. [°C]	Std. Dev. [°C]	Typ. Err. [°C]	Liquidus [°C]	Std. Dev. [°C]	Typ. Error [°C]	Phase transf.
A-XII	n.p.	-	-	n.p.	-	-	1189.5	1.5	2	1468.1	0.9	2	-
A-XIII	n.p.	-	-	n.p.	-	-	1108.3	0.8	2	1452.4	0.6	2	-
A-XIV	n.p.	-	-	n.p.	-	-	1039.7	0.3	2	1405.1	0.1	2	eutectic
A-XV	n.p.	-	-	n.p.	-	-	1042.1	0.5	2	1316.2	1.8	5	eutectic
A-XVI	n.p.	-	-	n.p.	-	-	1039.1	0.9	2	1273.9	0.6	5	eutectic
A-XVII	n.p.	-	-	n.p.	-	-	1038.8	0	2	1206.2	2.1	5	eutectic
A-XVIII	n.p.	-	-	n.p.	-	-	1037.2	0.3	2	1134.8	0	5	eutectic
B-I	1359.4	1.7	5	1373.0	1.7	10	1513.9	1.1	2	1531.1	0.5	2	left of cA
B-II	1380.1	0.5	5	1421.2	0.8	10	1501.8	0.5	2	1529.3	0	2	left of cA
B-III	1401.3	0.2	5	1452.9	0.7	10	1486.9	0.9	2	1527.5	0.3	2	left of cA
B-IV	1429.1	0.2	5	1479.0	0.2	10	1471.9	0.4	5	1524.6	0	2	cA-cB
B-V	1425.5	0	5	1477.9	0	10	1472.4	0	5	1525.1	0	2	cA-cB
B-VI	1452.4	2.6	5	1482.7	0.8	10	1475.2	0.2	5	1520.6	0.2	2	cA-cB
B_VII	1480.6	0.1	5	1485.8	0.2	10	1448.3	2.3	5	1515.9	0.2	2	cB-cC
B-VIII	1487.6	0	5	1488.3	0.1	10	1424.8	0.1	5	1507.6	0.2	2	cB-cC
B-IX	1490.0	0.1	5	1490.4	0.5	10	1410.6	1.9	5	1500.8	0.4	2	cB-cC
B-X	n.p.	-	-	n.p.	-	10	1357.7	2.1	5	1478.3	1.1	2	right of cC
B-XI	n.p.	-	-	n.p.	-	10	1303.1	2.1	5	1457.8	1.1	2	right of cC
B-XII	n.p.	-	-	n.p.	-	10	1234.4	1.1	5	1427.7	1.1	2	right of cC
C-I	1486.9	0.4	5	1489.8	0.1	10	1460.7	0.4	5	1517.5	0.3	2	cB-cC
C-II	1480.1	0.4	5	1485.9	0.1	10	1445.5	1.4	5	1516.3	0.1	2	cB-cC
C-III	1472.4	0	5	1481.5	0.8	10	1428.5	0.1	5	1514.6	0	2	cB-cC

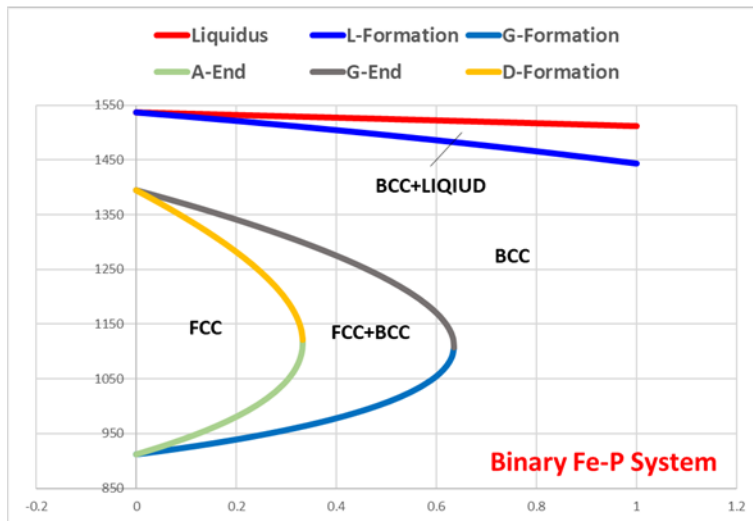
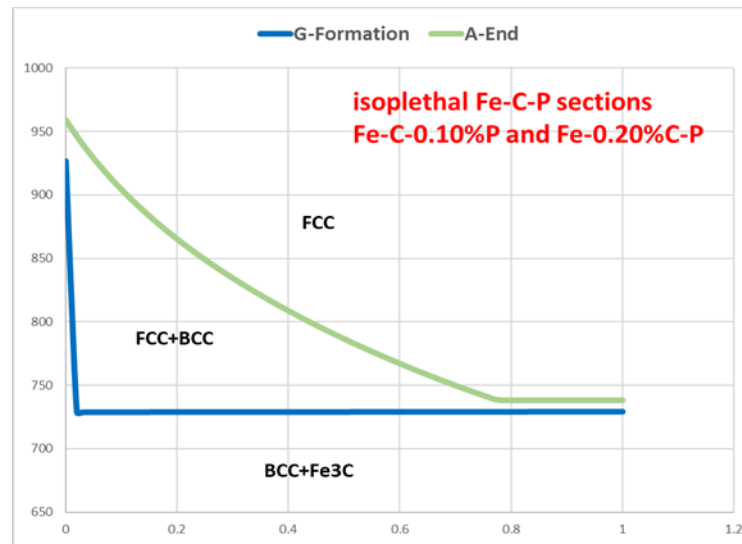
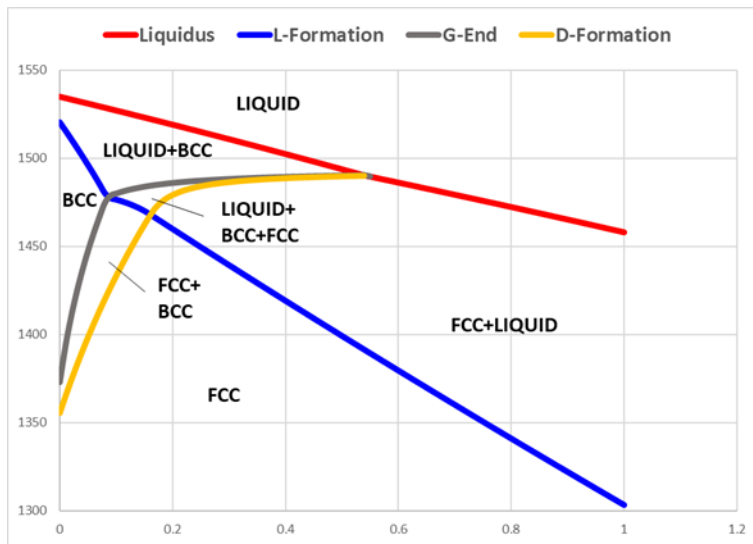
Table S-III: Detailed chemical analysis of investigated samples and phase transformation temperatures (part I), Fe-C-P with mass pct. ration C/P is 2

Alloy	Fe wt%	C wt%	Si wt%	Mn wt%	P wt%	S wt%	Al wt%	N wt%	γ -Form. [°C]	Std. Dev. [°C]	Typ. Err. [°C]	σ -End [°C]	Std. Dev. [°C]	Typ. Err. [°C]	δ -Form. [°C]	Std. Dev. [°C]	Typ. Err. [°C]
D-I	99.3288	0.170	0.002	0.015	0.430	0.0034	0.026	0.0028	744.7	0.3	5	n.m.	-	5	1416.9	2.1	5
D-II	98.8321	0.340	0.002	0.015	0.760	0.0035	0.024	0.0024	749.8	0.4	5	n.m.	-	5	1457.1	0.8	5
D-III	97.9659	0.680	0.002	0.016	1.275	0.0034	0.031	0.0057	759.6	1.3	5	777.8	0.6	5	n.p.	-	-
D-IV	95.5927	1.360	0.004	0.018	2.960	0.0037	0.027	0.0146	762.5	0.9	5	n.m.	-	-	n.p.	-	-

Table S-IV: Detailed chemical analysis of investigated samples and phase transformation temperatures (part II), Fe-C-P with mass pct. ration C/P is 2

Alloy	γ -End [°C]	Std. Dev. [°C]	Typ. Err. [°C]	L-Form. [°C]	Std. Dev. [°C]	Typ. Err. [°C]	Fe ₃ P-End [°C]	Std. Dev. [°C]	Typ. Err. [°C]	Liquidus [°C]	Std. Dev. [°C]	Typ. Err. [°C]	Solidif.
D-I	1456.6	0	5	1359.1	3.3	2	-	3.3	-	1507.0	0.4	2	c _B -c _C
D-II	1460.3	0.6	5	1194.2	0.2	10	-	0.2	-	1481.7	0.9	2	c _B -c _C
D-III	n.p.	-	-	996.4	0.8	2	1002.7	0.2	2	1421.7	0.7	2	-
D-IV	n.p.	-	-	956.2	0.4	2	967.8	1.3	2	1319.55	3.8	10	eutectic

Legend



Legend	
n.p.	phase transformation not present according to phase diagram
n.m.	phase transformation not measurable by DSC
Std. Dev.	Standard Deviation from at least 2 independent measurements
Typ. Error	Suggested typical error for consideration in thermodynamic databases