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As-C-Fe-Pb (Arsenic-Carbon-Iron-Lead)

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Recently, [2005Voi] determined the liquid miscibility gap and the distribution of As and C between the Fe-rich and Pb-rich liquids at 1200 °C in C-saturated melts of this quaternary system.

Lower Order Systems

No phase diagram is known for the As-C system. In the As-Fe system, three compounds are known: $FeAs_2$ (marcasite-type orthorhombic), FeAs (MnP-type orthorhombic), and Fe_2As (Cu_2Sb-type tetragonal). The mutual solubility between As and Pb is negligible. In the C-Fe system, the C content at saturation in Fe melts increases from 17.1 at.% at 1152 °C to ~21 at.% at 1600 °C. The C solubility in Pb melts is between 0.41 and 1.6 at.% in the temperature range of 1170-1555 °C. In the Fe-Pb system, there is very limited mutual solubility between Fe and Pb in the liquid and the solid states. The known phase diagrams for the above systems are given in [Massalski2].

The limited data on the liquidus surface in Fe-rich alloys of the As-C-Fe system and the solubility of C in As-Fe melts were reviewed by [1992Rag1]. The As-C-Pb system does not appear to have been investigated. For the As-Fe-Pb system, [1992Rag2] presented the miscibility gap between Fe-rich and Pb-rich liquids at 1200 °C. The shift of the Pb-rich boundary of the Fe-Pb system at carbon saturation was given by [1992Rag3].

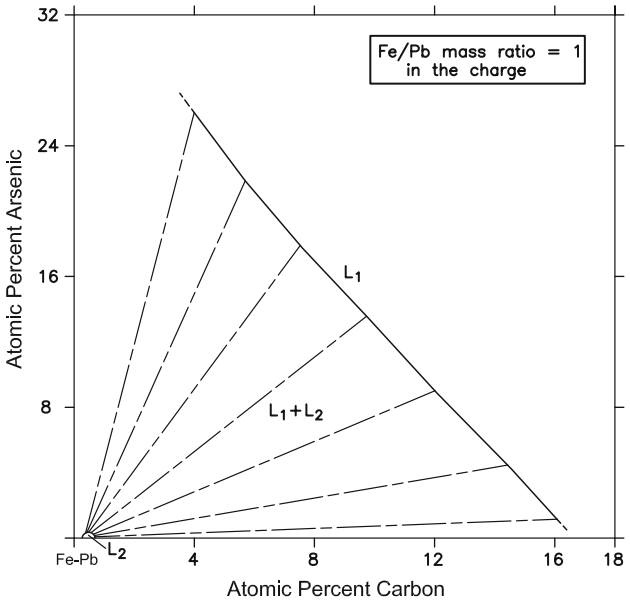

Fig. 1 As-C-Fe-Pb distribution of As and C between C-saturated Fe-rich liquid L_1 and Pb-rich liquid L_2 at 1200 °C [2005Voi]

Quaternary Phase Equilibria

[2005Voi] prepared elemental mixtures with a constant mass ratio of Fe/Pb = 1 and varying C and As contents. The samples were sealed in quartz ampules, melted, and kept at 1200 °C for 12 h, before quenching in water. The presence of two clearly separated liquids was confirmed by metallography and electron probe microanalysis (EPMA). The composition was determined by combustion infrared spectrometry for carbon and by EPMA and inductively coupled plasma spectrometry (ICP) for the other elements. The measured compositions of the coexisting liquids were listed.

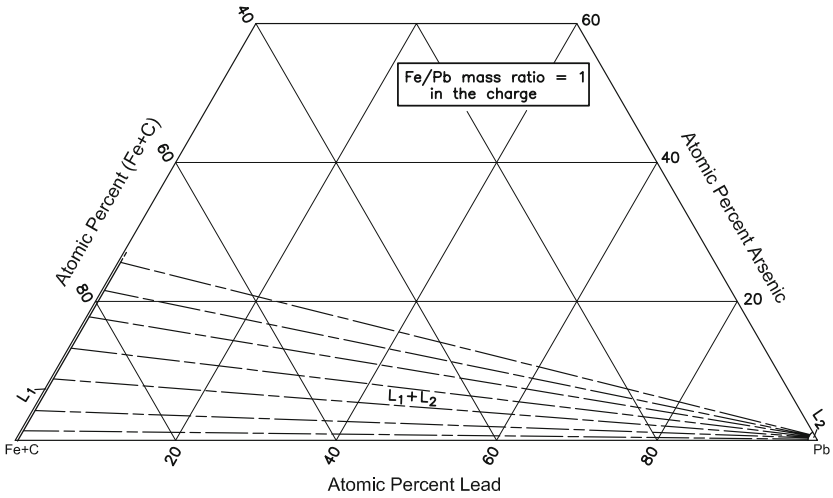

Fig. 2 As-C-Fe-Pb partial isothermal section at 1200 °C and at C saturation [2005Voi]

The As, C, and Fe contents of the Pb-rich liquid were found to be very small, up to 0.18, 0.03, and 0.42 mass%, respectively. The As, C, and Pb contents in the Fe-rich liquid were up to 32.8, 3.92, and 0.19 mass%, respectively. The observed variation in the As and C contents of the C-saturated co-existing Fe-rich liquid L_1 and Pb-rich liquid L_2 at 1200 °C is shown in Fig. 1 [2005Voi]. The liquid miscibility gap at C saturation is plotted in Fig. 2 as a function of As, Pb, and (Fe + C).

The effect of minor additions of Ag, Au, Cu, and Pt at 1200 °C was also studied by [2005Voi]. It was found that Ag segregated in the Pb-rich phase, Pt segregated in the Fe-rich phase, and Au and Cu distributed almost evenly between the two phases.

References

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1992Rag2: V. Raghavan, As-Fe-Pb (Arsenic-Iron-Lead), *Phase Diagrams of Ternary Iron Alloys, Part 6A*, Indian Institute of Metals, Calcutta, 1992, p 283-284

1992Rag3: V. Raghavan, C-Fe-Pb (Carbon-Iron-Lead), *Phase Diagrams of Ternary Iron Alloys, Part 6A*, Indian Institute of Metals, Calcutta, 1992, p 511

2005Voi: L. Voisin, H.M. Henao, M. Hino, and K. Itagaki, Phase Relations, Activities and Minor Elements Distribution in Fe-Pb-As and Fe-Pb-Sb Systems Saturated with Carbon at 1473 K, *Mater. Trans*., 2005, **46**(12), p 3030-3036