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# C-Cr-Fe-Mo-N-Nb-V

*V. Raghavan*

In a review of the C-Fe-N-Nb-Ti-V system by [2003Rag], a miscibility gap between NbC and VC was presented from the results of [1968Kie] and [2001Ino]. Recently, [2005Yos] reported a two-phase separation in MX (M = Nb, V, Cr and X = C, N) carbides during normalizing of Cr-Mo ferritic steels containing Nb and V.

## The Miscibility Gap in MX-Type Carbides

[2005Yos] induction-melted under vacuum a Cr-Mo steel with the following composition in weight percent: 8.93Cr, 0.98Mo, 0.22V, 0.067Nb, 0.09C, 0.051N, and other residual elements. The steel was normalized at temperatures between 1050 and 1250 °C for 10–60 min and cooled in air. The carbide precipitates were extracted on carbon replicas and analyzed by x-ray diffraction and energy dispersion x-ray spectroscopy. The carbonitride particles were found to have a range of composition along the line joining 100 wt.% Nb to 80 wt.% V-20 wt.% Cr on the Cr-Nb-V composition triangle. At 1050 °C, the composition distribution was in two clearly-separated ranges. At 1100 °C, the difference between the two ranges was less marked. These results are in agreement with those reported by [2003Suz]. On the basis of their results, [2005Yos] constructed a vertical section, which is shown in Fig. 1. The miscibility gap between Nb(C,N) and V(C,N) closes at ~1110 °C in contrast to NbC-VC gap closure at 1527 °C (see Fig. 1 in [2003Rag]). The large difference in the steel composition and the presence of other carbides in the microstructure could possibly be the reason for the difference.

A CALPHAD modeling of the miscibility gaps in transition metal carbide phases was presented recently by [2004Ser].

## References

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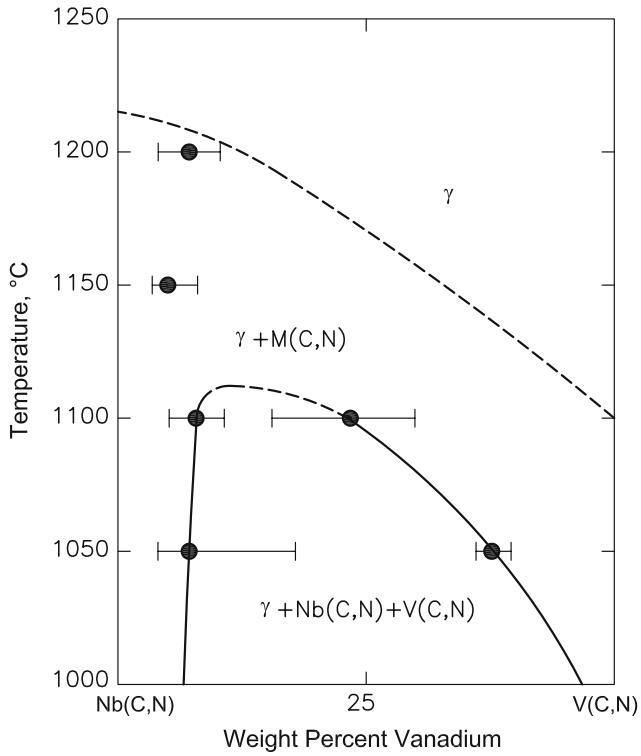


**Fig. 1** C-Cr-Fe-Mo-N-Nb-V carbonitrides in equilibrium with austenite (γ) [2005Yos]

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