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Debye temperature of sigma-phase Fe-V alloys

Among about 50 examples of a sigma-phase (tetragonal unit cell - structure type D144h P42/mnm) known to exist in binary alloy systems the one in FeV is of particular importance due to a wide composition-temperature range in which s can be formed as well as to the strongest magnetism it shows [1]. The former offers favourable conditions for investigation of compositional dependence of various physical properties as well as testing various theoretical models.
This contribution reports on Debye temperatures determined from a temperature dependence of the average centre shift, based on the Debye model, for a series of the sigma-phase Fe(100-x)V(x) samples with 34.4 < x < 59.0. As found, dependence of the Debye temperature on x is not monotonous, but two minima – one at x = 40 and the other at x = 48 – and a maximum at x = 43 are observed. Such behaviour and the fact that the amplitude of a change in the Debye temperture reaches ~40% is unexpected and it is quite puzzling. The behaviour will be discussed in a context of influence of composition on other physical properties characteristic of the samples such as Curie temperature, average isomer shift and average magnetic moment per Fe atom.
[1] J. Cieślak, B. F. O. Costa, S. M. Dubiel, M. Reissner , W. Steiner, J. Magn. Magn. Mater. 321 (2009) 2160

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