ysis lead to the same general results. Only the semantics are different! Chipman prefers the lucidity of partial molar free energies and infinitely dilute standard states.[1] The idea of a fcc chromium standard state requires special dispensation! On the other hand KNU[2] and the present author[3] prefer dealing with integral free energies and the pure metal standard state coinciding with the structure of the solution in question. The latter seems to be a far more physical definition than the infinitely dilute state. In this view fcc Cr is no more unusual than bcc iron at 1400 K, fcc iron at 1000 K or hcp iron at one atmosphere. The important result is that both methods can yield the same correct answers when handled properly and that arguments over which method gives clearer answers are pointless.

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Author's Reply

JOHN CHIPMAN

A paper of Dr. Kaufman's had unfortunately excaped the attention of the author. His equation for the s activity coefficient of chromium in fcc Fe-Cr alloys gives results at low concentrations which agree with those under discussion. My discussion is limited to dilute solutions within the gamma-loop and is not intended to apply to a pure fcc chromium.

Detection of Interstitials in Rimmed Steels by Means of Magnetic After-Effects

G. BÉGIN, R. ROBERGE, AND A. H. MARQUIS

The presence of carbon and nitrogen in solid solution is particularly harmful in low carbon rimmed steels intended for deep drawing applications. It was felt necessary to develop a technique to determine the interstitials content of such flat rooled products. We shall present in this communication the potential use of the diffusion magnetic after-effects for the detection of interstitials.

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The magnetization after-effects were first proposed by Néel.[1] These effects arise from the interaction energy between an occupied interstitial site in the basic lattice cell and the magnetization in that cell. A consequence of this interaction energy is that all the interstitial sites within a magnetic domain are not all energetically equivalent and the equilibrium distribution of interstitials within a domain gives rise to directional order. This order changes in domains separated by a 90 deg Bloch wall and of course across any kind of domain boundary where the magnetization vector rotates from cell to cell. The equilibrium distribution of interstitials, because it lowers the free energy of the system, stabilizes a given domain configuration. When a stabilized configuration is disturbed by the application of an external field H, some extra energy has to be supplied because the distribution of interstitials within the volume swept by the wall is not the equilibrium one. For a 90 deg wall, the extra amount of energy increases continually with the wall displacement because the number of interstitials left out of equilibrium by the passage of the wall also increases continually. On the other hand, for a 180 deg wall, the extra energy reaches a constant value with the wall displacement because only the interstitials within the wall thickness at the old and the new positions are left out of equilibrium by the passage of the wall. The additional restoring or stabilizing pressure on the initial position of the walls dE/du thus reaches a constant value as a function of u, the wall displacement, in the case of the 90 deg wall and goes through a maximum and vanishes as a function of u in the case of the 180 deg wall. Thus, the extra energy that we have to supply to change a stabilized domain configuration is a function of the displacement u (or the magnetic induction B) for small values of u. For large displacement of u the extra energy reaches a constant that depends to some extent on the number of 90 deg walls that moved upon the application of an external field. Phenomenologically, this extra energy or stabilizing pressure can be thought of as a stabilizing field similar to a demagnetizing field that always opposes the applied field but that gradually decreases with time as the interstitials adapt themselves to the new domain configuration created by the applied field. In polycrystalline material with isotropic domain configurations the magnitude of this field is a function of the interstitials content.

In principle, any experiment that is sensitive to the build-up of the new stabilized configuration via the diffusion of interstitials may be used to evaluate the magnitude of the stabilization field. We have studied the magnetic induction response to the application of a step function field in the Rayleigh region. An analysis of the time dependent part in a single experiment enables the identification of the nature of the interstitials responsible for the after-effects. The assumptions use for reversible displacements are the following:

—We assume that we are dealing with a stabilized domain configuration and that the effective field in the specimen is given by

$$H_{\text{eff}} = H_a - \Sigma_i H_{sti} \qquad [1]$$

where H_{sti} is the stabilizing field of a given specie i