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I. Introduction

Troiano and Greninger [1] and Kurdjumov [2] considered kinetics to be as important as crystallography in defining the characteristics of martensitic reactions. In supporting this view, I shall ignore the exigencies of the time-table and look backwards to nucleation as well as forwards to today's papers. I take as my starting point the excellent survey of kinetics and nucleation theory in ferrous martensite presented by Magee [3]. He distinguished two kinds of kinetic behaviour, "dynamically stabilized" and "isothermal", and further sub-divided the latter into cases where martensite forms predominantly in bursts during cooling and those in which most of the transformation is isothermal. To these categories, we must add thermoelastic martensite which occurs in many non-ferrous systems.

Magee concluded, in contrast to earlier theories, that the average volume of a martensite plate is independent of the volume fraction of martensite and that nucleation sites which are autocatalytically activated by previously formed plates are overwhelmingly more important than randomly-distributed pre-existing sites. He suggested that the rate-limiting step may be the propagation of the interface.

II. Thermodynamics

Although some displacive phase transitions may be thermodynamically second or higher order, the transformations which the metallurgist recognizes as martensitic involve large distortions of the unit cell and changes in symmetry and are all first order. It is then possible to define an equilibrium T_0 temperature by the intersection of two independent free energy curves, and to define a driving force as the difference between these curves (see Fig. 1). The free energy as a continuous function of configuration along some path from A to B in Fig. 1 may, more controversially, be given by a Landau expansion [4]

$$\Delta G = P\eta^2 + Q\eta^3 + R\eta^4 + \dots \quad (1)$$

where η is an appropriate order parameter which in the case of martensite represents a finite homogeneous deformation. Fig. 2 shows the relation between ΔG and η at different temperatures; the perfect parent phase becomes mechanically unstable at T_u when the minimum at $\eta = 0$ changes

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