J. Appl. Cryst. (1975). **8**, 127

Long-Wavelength Neutron Scattering Studies of the Decomposition of Al–Zn Alloys

BY C. D. CLARK, S. MESSOLORAS, E. W. J. MITCHELL AND R. J. STEWART

J. J. Thomson Physical Laboratory, Whiteknights, Reading RG6 2AF, England

(*Received* 29 *April* 1974)

The initial stages of the decomposition sequence of low-zinc-concentration aluminum alloys at room temperature, after being quenched from an annealing temperature in the range 175 to 400°C (*i.e.* from the α phase) are thought to be determined either by a spinodal mechanism or by a nucleation and growth mechanism giving rise to Guinier–Preston zones. In an attempt to resolve which of these mechanisms is operative long-wavelength neutron scattering measurements have been performed on Al–Zn alloys containing 1·5, 12 and 15 at.% zinc. These measurements have been made with the small-angle scattering apparatus at the HFR in Grenoble. The results of a study of the stages of the decomposition corresponding to aging times at room temperature between 2 min and 1 year are discussed. In addition some preliminary results on the dependence of the rate of decomposition upon the annealing temperature are reported.

J. Appl. Cryst. (1975). **8**, 127

Scattering of X-rays by Correlated Defect Distributions

BY I. GAAL

Institute for Technical Physics of the Hungarian Academy of Sciences, Budapest, Hungary

(*Received* 29 *April* 1974)

It may be essential in certain cases (*e.g.* non-dilute alloys and dislocations) to take into account the (pair and higher-order) correlations in the defect distribution. To this end the kinematic expression for the total scattered intensity was rewritten into the following form:

$$I(\mathbf{K}+\mathbf{g})=\sum_m \exp(ig\mathbf{A}m) \sum_n \exp S(\mathbf{K},n,m) \qquad (1)$$

$$S(\mathbf{K},n,m)=\sum_{p=1}^{\infty} \frac{1}{p!}\int\ldots\int \binom{p}{q} \prod_{l=1}^{q} \alpha_1(n,\boldsymbol{\rho}_l) \prod_{k=q+1}^{p} \alpha_2(n,\boldsymbol{\rho}_k)\, g^{q,p-q}(\boldsymbol{\rho}_1\ldots\boldsymbol{\rho}_2)\mathrm{d}\boldsymbol{\rho}_1\ldots\mathrm{d}\boldsymbol{\rho}_p$$

with

$$\alpha_j=\exp\{i\mathbf{K}[\mathbf{u}_j(n+m,\boldsymbol{\rho}_s)-\mathbf{u}_j(n_1\boldsymbol{\rho}_s)]\}-1 \quad (j=1,2)$$

where $\mathbf{K}$ is the Bravais vector of the reflexion, $\mathbf{u}_i(\mathbf{n},\boldsymbol{\rho})$ denotes the (elastic) displacement field at the lattice point $\mathbf{A}n$ caused by the ith kind of single defect (being at lattice point $\boldsymbol{\rho}$) and $g^{q,p-q}(\boldsymbol{\rho}_1\ldots\boldsymbol{\rho}_p)$ is one of the pth order Ursell–Mayer functions describing the correlation between q defects of $\mathbf{u}_1$ type and p–q defects of $\mathbf{u}_2$ type. For vanishing pth-order correlations the $s\geq p$th order Ursell–Mayer functions vanish and for vanishing second-order correlations equation (1) is equivalent to Krivoglaz's equation. For dislocations the second-order correlations are essential; at small m S is proportional to $m^2 \log[B^2(|\mathbf{A}m|)^{-2}]$, where B is the decay length of the screening-type second-order correlations. S is never proportional to K^2; there is a finite intercept on the Warren–Averbach plot, but it depends on m^2 and therefore it cannot be interpreted as an apparent particle size. At large m S is logarithmically divergent for dipole-like screening and it tends to a finite value for quadrupole screening. In the latter case the scattering intensity can be separated into Bragg and diffuse scattering.