13.3-4 ON MULTIPLE SMALL ANGLE SCATTERING. By S. Mazumder and A. Sequeira, Neutron Physics Division, Bhabha Atomic Research Centre, Trombay, Bombay 400085, India.

The multiple scattering effects in Small Angle Scattering have been analysed by an analytical approach. Two Limiting regions, viz. the Guinier region and the Porod region have been studied. The scattering has been viewed from the angle of Markoff process and the continuum limit has been taken into consideration. The distribution of the scattered beam has been worked out using the probability density function, $F(X,Y,\eta,\xi \mid Z)$, where, Z is the incident direction, η and ξ are the angles between the Z-axis and the projections of the tangent (at point (X,Y,Z) to the trajectory) on the XZ and YZ planes respectively.

Guinier Region

In the limit of large particle size, the diffusion equation pertaining to the probability density function can be expressed as

$$\partial F/\partial Z + \underline{u}.\,\mathrm{grad}_{\rho}\, F = D\,\nabla^2 u\, F \text{..........(I)}$$

where, $\underline{r} = X\,\underline{i} + Y\,\underline{j}$, $\underline{u} = \eta\,\underline{i} + \xi\,\underline{j}$, D is an analogue of the diffusion coefficient characteristic of the individual scatterer and the matrix as a whole. The solution of this generalised Fokker-Planck (F-P) equation, putting $q = k|\underline{u}|$ (k = wave no. of the radiation) can be expressed as

$$F(\underline{q}|Z) = \int F(\underline{r},\underline{q}|Z)\,d\underline{r} = (R^2/5\pi N)\,\mathrm{Exp.}[-q^2 R^2/5N], \text{..(II)}$$

where, R is the radius of the individual scatterer and N is the average no. of encounters made by the beam while traversing the sample thickness, Z. The solution implies that the linear dimension $R_{Guinier}$ of the particle obtained from the Guinier-plot should be modified as

$$R_{correct} = \sqrt{N}.R_{Guinier} \text{.........(III)}$$

Porod region ("$q \rightarrow \infty$")

From the consideration of Markoff process, the multiple scattered intensity profile $F_N(q)$ can be expressed in terms of single scattered profile F(q) as

$F_N(q) = F(q)^{*N}$,

where, $*N$ signifies N fold convolution.

In the limit of large q,

$$\mathrm{Lt.}_{q\rightarrow\infty} F_N(q) = \left[\int F(q)dq\right]^{N-1} .\mathrm{Lt.}_{q\rightarrow\infty} F(q) \text{.....(IV)}$$

The above relation is in agreement with the observations that multiple scattering intensity profile follows the same asymptotic trend as single scattering profile in the region $q \rightarrow \infty$. Hence Porod Law remains invariant under multiple scattering. In the polydisperse systems, the extracted $\langle R^2 \rangle$ from the Guinier-plot is related to the individual R_n by the relation,

$$\langle R^2 \rangle \simeq (1/N)\,\frac{\sum \beta_n (V_n \Delta D_n)^2 R_n^2}{\sum \beta_n (V_n \Delta D_n)^2} \text{...(V)}$$

where, β_n, V_n, R_n, ΔD_n respectively be the number fraction, volume, radius and the scattering density contrast of the n^{th} type of inhomogeneties. When β_n and ΔD_n are independent of n, then the equation (V) reduces to

$$\langle R^2 \rangle \simeq (1/N)\,\frac{\sum R_n^8}{\sum R_n^6} \text{,....(VI)}$$

which is a modified form of the well-known moment ratio.

13.5-1 TEXTURE ANALYSIS OF 3 METEORITIC SAMPLES BY NEUTRON DIFFRACTION. By S. Höfler, G. Will & W. Schäfer, Mineralogical Institute, University Bonn, West Germany

We have applied the new method of texture analysis by neutron diffraction to the investigation of three meteoritic samples: two hexahedrites from Coahuila and Walker County resp. and one Gibeon sample, an octahedrite. All samples are highly oriented.

On the hexahedrite specimens the reflections 200, 110 and 211 for kamacite were measured. in the Coahuila sample the pole figures reveal sharp and strong pole density maxima surrounded by very low background. Some smaller peaks in the pole figures can be attributed to 211 twinning (Neumann bands). In the Walker County specimen the pole figures are more diffuse as the result of the splitting of the original single crystal into several pieces with slightly different orientations.

In the Gibeeon sample we measured kamacite and taenite. The taenite pole figures have several peaks of pole density with a high background of nearly random distribution. The kamacite pole figures are not marked by discrete peaks, but reveal bands or groups of high density. The features are to be explained by the original relationship between taenite and kamacite.

These examples demonstrate the power of neutron texture analyis. The main advantages of neutrons are found in the low absorption and therefore high penetration of neutrons allowing us to study large smaples of 10x10x10 mm³ or more. Neutron diffraction is slower than X-ray analysis, howver by using a position sensitive detector and sophisticated profile analysis methods neutron diffraction will be much superior.