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Experimental study of fluctuations in materials*

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Abstract. Mechanical behaviour is decided by the structure and kinetics of defects in materials. External forces play an important role in determining the growth, decay and motion of defects. In addition there is an inherent fluctuation in the various microscopic characteristics of the system as the latter acts as a 'heat bath'. A disturbance that is set up in the system is affected by these fluctuations. The response of the system to external forces can be related to the behaviour of the system due to intrinsic fluctuations in the absence of impressed forces. This is the basis of relation between study of fluctuations in the system and various relaxation phenomena observed. It is proposed to discuss certain features of this subject in relation to various material properties.

Discussion

A P Pathak: What kind of information does one get about defects and defect structures from small angle neutron (or x-ray) scattering? For thin specimens charged particle scattering (channeling as well as backscattering) gives detailed information about all kinds of defects and defect structures. How do the two techniques compare as regards defect studies?

K R Rao: As I have explained in my talk, small angle scattering (x-ray or neutron) can give information on the *average* size, number and distribution of defects present in a solid (x-rays and neutrons give essentially similar information). Electron microscopy and charged particle scattering give useful information on point defects. Charged ionic particles in channeling experiments, for example, have helped one to decide whether certain impurities are substitutional or interstitial. However, such experiments generally require single crystals, and such studies have mostly been confined to 'ideal' defect studies. Small angle neutron scattering has the advantage that it can be used with bulk systems with large beam diameters, but the intensities are limited at present.

G Venkataraman: It seems to be of interest to consider, say, a creep experiment set up in a neutron beam. By studying the small angle scattering, one could perhaps learn something about the kinematics of defects during the course of deformation.

G Ananthakrishna: How do you measure the two-time correlation function in nonlinear systems?

Rao: I believe that *non-stationary* situations are the ones being investigated currently.

G Ananthakrishna: Binder remarks that coarse graining leads to fuzziness of the spinoidal boundary. How would one measure such an effect?

*Only a summary is presented.

Rao: My *guess* would be that perhaps one ought to start with compositions corresponding to the fuzzy boundary, and then carry out experiments quite similar to the ones I have already described.