## STATEMENT OF THE PROBLEM

During the last two decades, a considerable amount of work has been done on the chemical effects of nuclear transformations in solids. Two of the characteristic features of these irradiated solids are : (1) the similar annealing kinetics in spite of the wide differences in the nature of these solids[1] and (2) a high degree of stereospecificity observed in the annealing reactions.[2] A number of models[3-7] have been put forward to explain the post-irradiation annealing behaviour of the solids. Any model, suggested to explain the chemical effects of nuclear transformations in solids should be able to account for the observation of a high degree of stereospecificity in the concurrent and post-irradiation annealing reactions. The retention of configuration during the neutron irradiation and subsequent thermal annealing was found by Zuber *et al.*[2] in *dextro* - *tris* ethylenediamine-cobalt(III) nitrate and *cis* - and *trans* - dichloro-bis-ethylenediamine-cobalt(III) nitrate and by Maddock *et al.*[8] in a number of neutron irradiated geometrical isomers of nitroammine cobalt complexes. However, a significant percentage activity in the forms isomeric to the parent was found by Saito *et al.*[9] in *cis*- and *trans*- $[Co(NH_3)_4(NO_2)_2](NO_3)$ and by Maddock *et al.*[8] in *cis*- $[Co(NO_2)_2(NH_3)_4]$ *trans*-$[Co(NO_2)_4(NH_3)_2]$. All the earlier studies of the retention of configuration have so far been carried out only on stereoisomers of cobalt complexes.

In view of the conflicting results mentioned above it is desirable to find out whether the retention of the configuration is limited to a few cobalt complexes or can also be observed in the similar complexes of other metal ions. Part I of this thesis deals with a study of the degree of stereospecificity in the neutron irradiated cis- and trans-dichloro-bis-ethylenediamine chromium chloride.

The analyses of the recoil species produced in the neutron irradiated solids have invariably been done by aqueous chemistry. The nature of the recoil species in the solid state need not necessarily be the same as found in the solution of the irradiated solid. Some of the metastable species which exist in the solid state may be unstable in solution and hence would be converted into stable forms by oxidation, reduction and hydration reactions.[10] Consequently, different analytical techniques may not give the same results.[11,12] The recently discovered technique of Mossbauer Spectroscopy[13,14] can be utilized to throw light on the nature of the recoil nucleus and its environment in the solid state. In suitable cases, it is possible by means of the Mossbauer effect to detect different valency states of an element and also to observe the changes in its surroundings.[15-17] Part II of this thesis deals with a study of the chemical states of $^{57}Fe$ formed due to the Auger effect following the electron capture decay of $Co^{57}$ in some cobalt compounds of varying degree of covalency viz. $KCoF_5$, $CoCr_2O_4$, $CoCr_2S_4$ and Co(1-10 phenanthroline)$_3(ClO_4)_3.2H_2O$.