S U M M A R Y

The problem of the low energy electron (= < 15 eV) scattering by atoms and molecules is of interest not only in the field of physics but also in Chemistry, Biology,Engineering and medical sciences. The study of this problem is fundamentally attached with the radiation science because almost all kinds of ionizing radiations when interact with matter ultimately produce low energy electrons and as matter consist of atoms and molecules the study of slow electron interaction with atoms and molecules is necessary.

The motion of an electron in an electric dipole field has been considered recently as a model for low energy electron scattering by polar molecules. An attempt is made to study the slow electron polar molecule interactions from various aspects. The survey of the whole problem, experimentally as well as theoretically has been made and also our results are discussed at the end.

The thesis is divided into five chapters.

The first chapter deals with the development of the experimental methods and the results of these methods are discussed. After ingrossing into varіous elementary collision

terms, a historically important experiment for the measurement of total cross section is described in brief. When electron swarm or beam passes through the gas it diffuses. The cross section concerning the diffusion of electron in a gas is also a very important factor. This diffusion or momentum transfer cross section was experimentally first determined by Townsend. Townsend's experiment is also described in brief. Over and above the Townsend and Ramsauer experiments, the recent progress in the experimental techniques and its implications on cross sections are described. Finally some of the interesting experimental results for polar molecules are discussed also.

In the second chapter the historical account of the theoretical studies of the whole problem is given. The various theoretical techniques and their contributions to the cross sections are discussed. The various modifications in the molecular model, potential and other important factors concerning molecules are also considered. Comparisions of the theoretical results and the experimental results are also made.

In the third chapter the phase shift calculations are reported. Various methods are used to determine the phase shifts of the low energy electron in the dipole field. These values of phase shifts are compared with other theoretical values. Also it is used for cross section calculations. The calculations are made for different dipole strength and for the various values of ' l '.

In the fourth chapter the study of momentum transfer cross section is made. One of the very interesting point of this problem is the success of Born approximation. It is observed by the partial wave analysis that the success of Born approximation is, first of all, due to the long range nature of the relavant interaction, and secondly due to the fact that the 'S' wave which is the only partial wave to be distorted considerably, in the low energy collision, under consideration does not contribute appreciably to the rotational transitions. Though Born approximation can be applied successfully to some extent it does not give the complete picture of the scattering cross section. Looking to this fact the variational approach to the problem is made. Schwinger's variational method developed by L. Mower have been applied. A selection of the trial wave functions slightly different than Born approximation are used in the calculations. Calculations for momentum transfer cross section for "S" state are made for 35 polar molecules. The results of these calculations are in agreement with Mittleman and Vonholdt calculations. The problem is also studied by considering molecule as having finite dipole potential. The application of Born approximation to finite dipole shows that there is resonance behaviour for the molecules having different dipole moments. This results are similar to Takayanagi and Itikawa. The energy dependence of momentum transfer cross section and temperature dependence of the mean scattering cross section are also discussed for various polar molecules. The application of screened dipole potential, quadrupole potential etc. are also made by different workers. It is observed that point dipole potential gives the maximum agreement with experiment. For improving the results and avoiding certain uncertainties in bound states a short range potential term over and above the dipole term was introduced. The one centered Coulomb screening repulsive and attractive potential, with proper choice of screening constants and other parameters gives satisfactory agreement with the experimental results. An attempt is made to estimate the mean scattering diffusion cross section, for thermal electrons, by all the above mentioned modifications.

In the fifth chapter the resonance scattering is considered. Inspite of the detail study of electron - polar molecule interaction by various authors it was observed that larger cross section of some of the molecules, namely H_2O, H_2S, HCl, can not be well explained. For the explanation of the larger cross section for such molecules it was suggested by Turner that electron might be captured temporarily by a molecule. A passing electron can exert a torque on the molecular dipole and might excite the molecule to a higher rotational state. The electron might loose enough energy in doing this to form a bound ionic or quasi trapped state in the field of dipole. The natural decay of this temporary state would supply electrons back in to the swarm, Thus introducing a contribution to the momentum transfer cross section. The study of this type of nuclear excited Feshbach resonance is made in detail. By using an improved wave function for the final bound state of electron and also the variational approach to the scattering amplitude the life time of temporarily formed negative ion and capture cross section are determined. The same study has been repeated for finite dipole potential. Finally the conclusions are discussed.