Effect electric field on water molecules changes the electron density and hence their dipole moment of external

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ABSTRACT

External electric field changes distribution of the electron density. Application of external electric field induces the polarizability of electrons, atoms and dipoles, resulting in eventual reorientation of the molecules along the applied electric field of the molecules and the electron density redistribution at particular atoms. Increase in the field strength generated mostly irregular changes of electron densities at particular atoms of the molecules as well as polarizations. Energy of these molecules and dipole moments also varied with the strength of the field applied.

The electric field concentrates the negative charge on the oxygen atom. The negative charge declines from -0.383 to -0.414 and, at the same time, the positive charge increased from 0.191 to 0.207. Thus, water molecule becomes more acidic and more prone to form dimmers, trimmers and so on. Such behavior can be responsible for several peculiar, poorly understood properties of water. Visualization of the iso-surface of water molecules documented the changes in the distribution of electron density and, hence the dipole moment and mutual intermolecular interactions.

Electronic spectra of H_2 and H_2O situated in electric field of 0.001-0.1 au were simulated. In the spectrum of system of 5 water molecules totally 4000 transitions in UV region are considered and among them only 199 transitions are characterized by f>0.0000. The transitions are situated in the region from 111.3 to 27 nm. The fivefold increase of water molecules makes the system more stable by 0.056274896 au (1au=931J). The electric field of 0.01au reduces the number of active transitions with f>0.0000 from 217 to 214. Applied field makes the structure of particular transitions entirely different from these in the field-unperturbed spectrum. Application of the 0.01au field stabilizes the system of five water molecules in respect to that without influence of the field. The stabilization energy reaches relatively high value of 1.091433217au.The stabilization can result from the facilitation of the formation of intermolecular hydration bonds.

Theory was presented on the growth of water droplets by the effect of an external electric field. It has been shown that the action of an electric field can accelerate the condensation of water vapor by a factor depending upon the intensity of the electric field. Experimentally the effect of electrostatic field on ice formation has been shown. The analysis indicated that dipole polarization of water molecules by the electrostatic field is the primary factor in this phenomenon. Under electrostatic field water molecules have a tendency to align with the electrostatic field. Water molecules with dipole moments along the direction of electrostatic field are the most stable and have the maximum value for the Boltzmann distribution function. It have been shown effectively that the external electric field applied to super cooled hail forming clouds can suppress the hails and reduce the possible loss to society.

Key words: Plasma, iso-surface, dipole moment, electron density, electronic spectra, dipole polarization.