## Summary

Electrophoresis is the migration of charged particles or molecules in a medium under the influence of an applied electric field. Any electrically charged particle dissolved in aqueous solution, when placed to a constant electric field, will start to migrate towards the electrode bearing the opposite charge; the speed of the particle movement will be directly proportional to the applied voltage and particle charge, but inversely proportional to the particle size. The common purpose for carrying out electrophoretic experiments include: (i) to determine the number, amount and mobility of components in a given sample and/or to separate them, and (ii) to obtain information about the electrical double layers surrounding the particles.

In 1807, Ferdinand Frederic Reuss for the first time observed clay particles dispersed in water migrated on applying constant electric field. The rate of migration of particle depends on the strength of the field, net charge, size and shape of the molecules and on the ionic strength,

viscosity and temperature of medium in which the molecules are moving. The first recorded measurements of electrophoretic phenomenon were performed in 1861 by Quincke. The most important early theoretical studies in electro-kinetics were made by Helmhotz, Smoluchowski, Gouy, Debye, Huckel, Abramson, and Macinnes. Tiselius, by describing his moving boundary apparatus in 1937, was instrumental in popularizing the utility of electrophoresis to the biochemist. Upon suspension in an aqueous solvent, almost all particles (*e.g.,* red blood cells, bacteria etc.) and many important biomolecules (*e.g.,* nucleotides, nucleic acids, amino acids, peptides, proteins etc.) acquire either positive or negative charges. The acquisition of such charges depends upon the nature of the particle/molecule and the solvent. For example, protein molecules, which have a large number of ionizable amino and carboxyl groups on their surfaces. These groups determine the net charge density of the protein molecule which makes it move in an electric field in a direction and at a velocity dependent upon the net charge density. This net charge

density, although dependent upon the chemical groups and their number present in the molecule, is modified by the nature of the solvent. Thus, if the acidity of the solvent is increased, the molecule will tend to become more positive and vice versa. Electrophoresis is not limited to charged molecules only. Even typically uncharged biomolecules such as carbohydrates can be made to develop weak charges through in the form of borates and sometimes as phosphates.

A charged particle migrates towards the oppositely charged electrode. Arrow 1 indicates movement of a particle bearing a net charged density of -1. Arrow 2 indicates faster movement of a particle bearing a net charge density of -2. Arrow 3 indicates a direction of frictional force.

The two molecules that have the same charge, however, migrate differentially due to the difference in their molecular weights and charge-to-mass ratio (this difference is of more use in electrophoresis on gels).