Electro-optical research of surface conductivity of colloid particles

M.P.Petrov[1*], S.A. Klemeshev[1], V.N. Shilov[2], A.A. Trusov[1], A.V. Voitylov[1], V.V. Vojtylov[1]

[1]*St. Petersburg State University, St. Petersburg, Russia*

[2]*Institute of Biocolloidal Chemistry, Kyiv, Ukraine*

**em.p.petrov@spbu.ru & mihaeles@list.ru*

In this work we present the experimental results of the study of surface conductivity in colloids and the electro-optical experimental techniques used to obtain them. Surface conductivity is an important characteristic of the interface which, just like charge, surface potential and electro-kinetic potential characterizes the double electric layer of particles and influences the stability of the solution. The theory of particle polarizability [1] defines the relation between specific particle surface conductivity, their size, shape, and their polarizability. This theory considers particle polarization together with that of dispersive media and ionic atmosphere surrounding the particles to describe the dispersion of electric polarizability of particles in the media in a wide range of electric field frequencies. Experimental study of particle polarizability allows to determine surface conductivity and the influence of ionic strength of the media on the latter. Mean values of particle polarizability can also be determined when studying the increment of electric conductivity of the colloid. Application of external fields induces orientation of non-spherical particles, which causes anisotropy of electric, dielectric and optical properties of the colloids. Since most colloids scatter incident light considerably, it is easy to observe electro-optical effects defined by anisotropy of light scattering, such as conservative dichroism. To conduct the experimental study of colloid particle surface conductivity we have constructed an experimental setup that employs electro-optical technique based on the study of conservative dichroism of colloids in electric fields of different types and frequency. The measurement of optical anisotropy using such a technique as a function of field strength and frequency allows to study polarizability and determine the size of colloid particles. In polydisperse systems it is possible to determine the distribution functions on these particle parameters and control the aggregative stability of the system during the experiments. Using particle polarizability model [1] it is then possible to determine the surface conductivity of the interface.
An experimentally determined dispersion of conservative dichroism for diamond aqueous colloid on the frequency of the applied electric field in frequency range 500 Hz – 4 MHz is in good agreement with the theoretically computed dispersion dependence if we take into account the distribution of particles on their size and shape. Good agreement of the theoretical and experimental curves testifies to the applicability of the employed theory of particle polarizability to study particle surface conductivity. The obtained magnitude of diamond particle surface conductivity is in good agreement with the magnitudes obtained using other techniques. Analogous results were obtained for several other colloids with particles of different shape, size, and origin.
Conclusions: 1. The employed theory of particle polarizability is applicable to the study of electric properties of studied colloid particles. 2. The obtained magnitudes of surface conductivity is in good agreement with those obtained before.

Acknowledgements. This work was supported by RFBR grant 16-03-00495A and by the St. Petersburg State University research grant (11.38.267.2014). Scientific researches were performed at the Interdisciplinary Center for Nanotechnology of Research park of St.Petersburg State University.

[1] V.N. Shilov, Yu.B. Borkovskaia and S.N. Budankova, In "Molecular and Colloidal Electro-Optics", 2007, Surf. Sci. Series, v. 134, ch.2, pp. 39-57, CRC, Taylor & Francis.