

Preliminary analysis of the electrical charge distribution within liquids using PEA

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Abstract:

The Electrical Double Layer (EDL) is the result of physico-chemical reactions taking place between a solid and a liquid and leading to the polarization of the interface. It is responsible for electrokinetic phenomena and then can be beneficial (electro-osmosis) or an issue (flow electrification) in multiple industrial applications. Experimental methods (zetametry, ECT) are used to characterize parameters of the EDL (wall charge density, zeta potential). However, these methods are indirect and require modeling and assumptions that remain to be confirmed. The need for new direct measurement methods applied to solid/liquid interface has arisen.

In this context, the Pprime laboratory designed new measurement methods able to provide a direct measurement of the space charge of the EDL. Thanks to collaborative work between the Pprime laboratory and the LAPLACE laboratory, a pulsed electro-acoustic (PEA) measurement of the EDL was developed. The PEA is a method for determining the space charge distribution in solid dielectrics. It relies on the application of a pulsed electrical field. Due to the stimulus, the electrical charges are subjected to a force and slightly move around their equilibrium positions, generating an acoustic wave that is converted into a voltage by a piezoelectric transducer. From this signal and the use of a suitable deconvolution method, the electrical charge distribution can be retrieved.

The PEA measurement developed for liquids provides voltage signals representative of the electrical charge distribution in a broad range of liquids. However, there are no deconvolution methods allowing to retrieve the electrical charge distribution for liquid samples.

By using the PEA measurement discussed above, this paper proposes to study experimental results obtained with various liquids, in different configurations (sample thicknesses) and under varying stimuli (voltage impulse levels), and to elaborate preliminary analysis methods of the results obtained.

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