Simulation of nonlinear waves interaction on the boundary of dielectric liquid with finite depth in a strong tangential electric field

Kochurin E A$^{1,\odot}$ and Zubarev N M$^{1,2}$

$^1$ Institute of Electrophysics of the Ural Branch of the Russian Academy of Sciences, Amundsen 106, Ekaterinburg 620016, Russia
$^2$ Lebedev Physical Institute of the Russian Academy of Sciences, Leninsky Avenue 53, Moscow 119991, Russia

$\odot$ kochurin@iep.uran.ru

Nonlinear dynamics of the free surface of finite depth non-conducting fluid with high dielectric constant under the action of strong tangential electric field is investigated in the present work. The equations of boundary motion admit exact solution in the form of nonlinear localized waves of arbitrary shape propagating without distortion along the surface of liquid in the direction of (or against the direction of) the external field. Despite the fact that the nonlinear waves can separately propagate without distortion, the interaction of counter-propagating waves can result in deformation of the boundary. Numerical modeling methods based on using of dynamic conformal transforms of the region occupied by the fluid into parametric strip of auxiliary variables were chosen for the study of interaction of the oppositely traveling waves. The simulations show that nonlinear waves are actually deformed in result of their collisions; herewith the effect of nonlinearity is inversely proportional to the liquid depth, i.e. deformation increases with depth decreasing. This work was supported by the Ministry of Education and Science of the Russian Federation (state contract No. 0389-2014-0006); by the Russian Foundation for Basic Research (project Nos. 16-38-60002, 16-08-00228, 17-08-00430); by the Presidium UB RAS (project No. 15-8-2-8); and by the Presidential Programs of Grants in Science (project No. SP-132.2016.1).