ENERGY SAVING TECHNOLOGIES OF ADVANCED MEMBRANES FOR WATER DESALINATION

Z. Insepov[1,2]*, K. Tynyshtykbayev[1], G. Imanbayev[1], A. Ainabayev[1], B. Berdenova[1],K. Dybyspayeva[1], Z. Ramazanova[1], N. Kuzembayeva[1], G. Bulekbayeva[1]

1) Nazarbayev University Research and Innovation System, Astana, Kazakhstan; *zinsepov@nu.edu.kz; 2) Purdue University, West Lafayette, IN, USA

Introduction. Actuation of fluid flow in nanochannels by surface and volume acoustic wave (SAW, VAW) propagation were studied. Increase of infiltration rate of fluid flow through porous media, fabrication of Labs-on-a-Chip (LOC), fast analysis of environmental pollution in field conditions using micro- or even nanoscopic amount of samples, in pumping gases and liquids through the channels with diameters as small as 1-10 nm and 1-10 цш were addressed.

Materials and methods. Comsol Multiphysics software to simulate flow in microtubes driven by influence of acoustic field was used [1]. Several systems based on acoustic wave propagation were simulated: 1) fluid circulation within the droplet by Rayleigh wave propagation on the surface of piezoelectric substrate, 2) droplet displacement and deformation of its free surface under SAW propagation, 3) propagation of acoustic pressure in the water tank emitted by the ultrasonic transducer at the bottom of the vessel, 4) water fountaining through capillary tube immersed in water tank, 5) propagation of Rayleigh traveling waves on a nanochannel surface and actuation a macroscopic flow of the gas/ liquid molecules inside the tube.

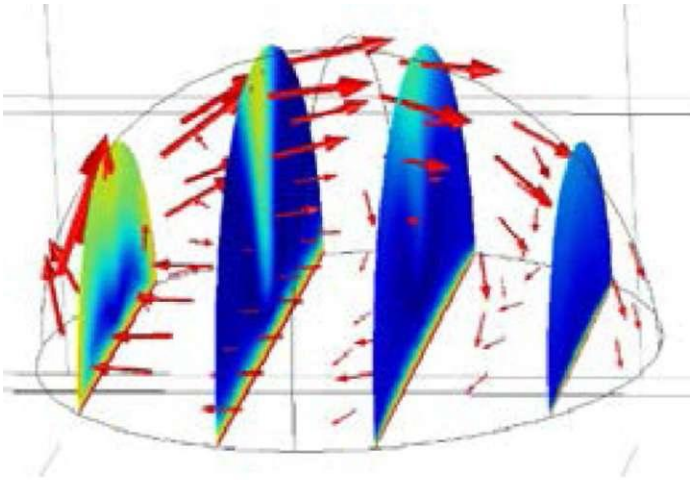

Figure 1. Fluid circulation within the droplet actuated by SAW propagation on the surface of piezoelectric substrate generated by inter digital transducers (IDT).

Results and discussion. Some results of simulation for each system working on acoustic wave propagation are illustrated in Fig.1 [2,3]. Depending on kind of systems, simulations were performed for various values of different parameters such as tube diameter, the immersion depth of the capillary tip, frequency of SAW, power of transducer etc., in order to compare the calculation results with the curves obtained experimentally. We observed amplification of SAW on the surface of piezoelectric with graphene coating*. The formation of nanochannels in carbon materials, in particular in the graphene oxide, was caused by neutral molecules cluster irradiation.

Conclusions. During last decades numerous attempts to simulate the acoustic streaming excitation were reported in literature. Most of them set the influence of acoustic field by time averaged volume force. We tried to specify the real SAW shaped deformation on the wall, to simulate the attenuation of elastic surface energy, and conversion of absorbed energy into volume force that initiates the fluid streaming.

References.

1. Comsol Multiphysics Software (http://www.comsol.com/).
2. Z.Insepov et al. Modeling of liquid pumping via microchannels, Nanotech Conference, 2014.
3. Patent application "A method for enhancing the surface acoustic wave" №11901 from April 4, 2014.

* One KZ patent and three research papers were published in the US high-impact journals.