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Electro-hydrodynamic effects on lipid membranes in giant vesicles

MARGARITA STAYKOVA, TETSUYA YAMAMOTO, REINHARD LIPOWSKY, RUMIANA DIMOVA, Max Planck Institute of Colloids and Interfaces, Department of Theory and Biosystems, Potsdam, Germany — Electric fields are widely applied for cell manipulation in numerous micron-scale systems. Here, we show for the first time that alternating electric fields may cause pronounced flows in the membrane of giant lipid vesicles as well as in the surrounding fluid media. The lipid vesicles are not only biomimetic model for the cell membrane but also have many potential biotechnological applications, e.g. as drug-delivery systems and micro-reactors. The reported effects should be considered in electric micro-manipulation procedures on cells and vesicles. They might be useful for applications in microfluidic technologies, for lipid mixing, trapping and displacement, as will be demonstrated. We also believe that our method for visualization of the lipid flows by fluorescently labeled intra-membrane domains will be helpful for studies on membrane behavior in vesicles subjected to shear or mechanical stresses.

Margarita Staykova
Princeton University, Department of Mechanical and
Aerospace Engineering, Princeton, NJ, USA

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