

Abstract Submitted
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Non-Linear Oscillation in Ionic Current Due to Size Effect in Glass Nanopipette¹ TOMOHIDE TAKAMI, XIAO LONG DENG, JONG WAN SON, EUN JI KANG, TOMOJI KAWAI, BAE HO PARK, Department of Physics, Konkuk University — We studied the size effect of the ionic current in glass pipette, and found an interesting 2.7 mHz oscillation at 50 nm. In this study, we would like to discuss the mechanism of the non-linear oscillation. Cation-rich layer with its Debye length λ exists in nanopipette, and its conductivity σ_d is lower than that in the central bulk layer σ_b in this study. The pressure difference $\Delta P = \Delta cRT$ where Δc is the difference in concentrations between in and out of the pipette. Then, the ionic current I can be estimated by using Hagen-Poiseuille equation;

$$I = \frac{\pi}{8\eta} \frac{\Delta cRT}{\ell} \left\{ \sigma_d r^4 + (\sigma_b - \sigma_d) (\lambda - r)^2 (r^2 + 2r\lambda - \lambda^2) \right\}.$$

(r : inner radius, ℓ : pipette length, η : viscosity) The last term indicates the non-linear oscillation. Moreover, we roughly estimated $\lambda = 2.08 \times (2r)^{1/2}$. Then, the bulk layer appears appropriately when $2r \sim 50$ nm, which causes the effective ionic current oscillation.

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