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Paper Title: Effect of CNT Length on Channel Formation in Lipid Bilayers

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Abstract

Artificial channels that transport substances in and out of cell membranes are being actively studied for analytical techniques, drug delivery, and other applications. One of them is carbon nanotubes (CNTs). CNTs are tubular carbon material with a few nanometers in diameter whose hollow structure allows ions and small molecules to pass through easily. When single-walled CNTs are cut into several to several tens of nm in length and coated with phospholipids (ultrashort CNTs, US-CNTs), the US-CNTs spontaneously insert into the cell membrane and artificial lipid bilayers. Furthermore, US-CNTs have attracted attention as artificial ion channels whose mechanical and chemical properties can be modified to control their permeability. The principle of US- CNTs forming channels in lipid bilayers has been studied by molecular dynamics simulations. However, few experimental studies have investigated the ability of US-CNTs to form channels in membranes. In this study, we estimated the channel formation ability of US-CNTs by measuring the channel current signals of US-CNTs with different length distributions. The results show that the channel current signal pattern differs depending on the length distribution, suggesting that length affects the ability of CNTs to form channels in membranes.