Biomimetic cyclodextrin nanotubes for Ion-channel Applications: Design, synthesis and ionic conduction

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Abstract

For few years, we observe the development of biomimetic channels for DNA sequencing such as carbon nanotubes, inserted into bilayers in despite of their hydrophobic properties[1,2], or aerolysin nanopore for the discrimination of polymers[3] or oligonucleotides[4] of different lengths. Recently, biomimetic synthetic channels were developed based on DNA duplex[5] or more complex DNA-based origamis[6,7,8,9] to design new tools for DNA sequencing or barcode based biomarkers[10]. These new channels will own a high confinement due to their thin internal diameter without using a cyclodextrin based adaptor[11,12,13]. Based on our knowledge of modified cyclodextrin channels[14], we synthetize biomimetic cyclodextrin nanotubes while keeping a cylindrical confined geometry[15]. As synthesis of these nanotubes is precisely controlled, we modify their diameter by using α-, β- or γ-cyclodextrins, their lengths with a monodisperse distribution according to TEM imaging and their functionalization to enhance their life time. We show that the conductance of these sub-nanometer nanotubes is governed by the same ionic transport as in gramicidin channels. These synthetic channels are not cytotoxic, leading to biomedical applications.

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