A pH-Tunable Nanofluidic Diode with a Broad Range of Rectifying Properties

Ali M, Ramirez P, Mafé S, Neumann R, Ensinger W
ACS Nano, Vol. 3, No. 3, (2009) 603-608

The use of fixed charge nanopores in practical applications requires tuning externally the electrostatic interaction between the charged groups and the ionic permeants in order to allow integrating a variety of functions on the same nanostructure. We design, produce, and characterize, theoretically and experimentally, a single-track amphoteric nanopore functionalized with lysine and histidine chains whose positive and negative charges are very sensitive to the external pH. This nanofluidic diode with amphoteric chains attached to the pore surface allows for a broad set of rectification properties supported by a single nanodevice. A definite plus is to functionalize these groups on a conical nanopore with well-defined, controlled structural asymmetry which gives virtually every rectification characteristic that may be required in practical applications. Nanometerscaled amphoteric pores are of general interest because of the potential applications in drug delivery systems, ionexchange membranes for separation of biomacromolecules, antifouling materials with reduced molecular adsorption, and biochemical sensors.