HETEROSTRUCTURED NANOCHANNELS WITH MODULATED IONIC CURRENT RECTIFICATION FOR ULTRASENSITIVE DETECTION OF HG2+

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ABSTRACT

Artificial membranes with asymmetric nanopores are similar to biological membranes with ion channels. The selective and rectified ion transport property of artificial membranes is of great significance for developing electrochemical sensors with highly sensitive detection performance. Herein, we propose a fast and facile approach for the sensitive detection of metal ions or charged molecules by constructing an asymmetric nanochannel structure using a cation-selective Nafion membrane and a DNA-functionalized anodic aluminum oxide (AAO) membrane. Arising from the varying charge distributions induced by the recognition of targets by DNA probes, the Nafion/AAO heterostructured nanochannels exhibit high ionic current rectification and excellent Hg2+ regulated current responses. The present sensor with heterostructured nanochannels can realize the detection of Hg2+ with a low detection limit of 1 pM, due to the unique ionic transport property of asymmetric nanochannels and the sensitive electrochemical detection method. The sensing mechanism is also confirmed by numerical simulations, demonstrating that the differences in the rectification ratios in the heterostructured nanochannels are caused by the varying surface charge densities in AAO nanochannels. This simple and facile heterostructured sensor has the advantages of simple preparation, easy modification, simple instrumentation and high sensitivity, which possesses great potential in the detection of metal ions or

charged molecules.

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