Geometrical effect in 2D Nanopores

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A long-standing problem in the application of solid-state nanopores is the lack of the precise control over the geometry of artificially formed pores compared to the well-defined geometry in their biological counterpart, i.e. protein nanopores. To date, experimentally investigated solid-state nanopores have been shown to adopt approximately circular shape. A unique property of hexagonal boron nitride (h-BN) few-layers has been revealed by previous transmission electron microscopy (TEM) studies, where triangular defects or nanopores can be created or enlarged while maintaining their intrinsic triangular shape.[1,2] Here, we investigate the geometrical effect of the nanopore shape on ionic blockage induced by DNA translocation using triangular h-BN nanopores and approximately circular molybdenum disulfide (MoS_2) nanopores. We observe a geometry-dependent ion scattering effect, which is further corroborated by a modified ionic blockage model. The well-acknowledged ionic blockage model is derived from uniform ion permeability through the 2D nanopore plane and hemisphere like access region in the nanopore vicinity.[3,4] Based on our experimental results, we propose a modified ionic blockage model, which is highly related to the ionic profile caused by geometrical variations. Our findings shed light on the rational design of 2D nanopores and should be applicable to arbitrary nanopore shapes.

References

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