pH-dependent water permeability switching and its memory in 1T' MoS_2 membranes

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In recent years, 2D material-based membranes have attracted significant attention for their potential applications in various fields, such as water desalination, gas separation etc. So far, most of the developments have been focused on improving efficient separation processes for industrial applications. However, in the last few years, there has been some effort toward making next-generation intelligent membranes. Intelligent translocation of molecules is one of the vital roles of biological membranes. Mimicking such systems can help us develop smart membranes, which can autonomously change their permeation depending on the external environment and would play a pivotal role in intelligent technologies for tomorrow.

In this talk, I shall discuss about our recent work, where we developed MoS_2 membranes that show phase responsive transport of water molecules and prove that only 1T' phase of MoS_2 is water permeable. We demonstrate the memory effects and stimuli responsive transport through such 1T´ MoS_2 membranes by executing water and ion permeation that follow a pH-dependent hysteresis with a permeation rate that switches by a few orders of magnitude. We further illustrate the potential application of this phenomenon in autonomous wound infection monitoring and pH-dependent nanofiltration.[1]

References

[1]"pH-dependent water permeability switching and its memory in 1T' MoS_2 membranes." C. Hu, A. Achari*, P. Rowe, H. Xiao, S. Suran, Z. Li, K. Huang, C. Chi, C. T. Cherian, V. Sreepal, P. D. Bentley, A. Pratt, N. Zhang, K. S. Novoselov, A. Michaelides, R. R. Nair*. Accepted in *Nature* (2023) (https://arxiv.org/abs/2301.10195v1

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